FLUKE®

DAC# 02019903
02023533
02025918
02033407

NOTE

This manual documents the Model 2200B and its assemblies at the revision levels shown in Appendix 7A. If your instrument contains assemblies with different revision letters, it will be necessary for you to either update or backdate this manual. Refer to the supplemental change/errata sheet for newer assemblies, or to the backdating sheet in Appendix 7A for older assemblies.

2200B
Data Logger

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Instruction Manual

02025915

P/N 502682
December 1978

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Rev. 6/81

Table of Contents

SECTION	TITLE		PAGE
1	**INTRODUCTION AND SPECIFICATIONS**		**1-1**
	1-1.	INTRODUCTION	1-1
	1-14.	SPECIFICATIONS	1-3
2	**OPERATING INSTRUCTIONS**		**2-1**
	2-1.	INTRODUCTION	2-1
	2-3.	SHIPPING INFORMATION	2-1
	2-6.	INPUT POWER	2-1
	2-8.	RACK INSTALLATION	2-1
	2-10.	OPERATING FEATURES	2-1
	2-12.	OPERATING NOTES	2-1
	2-14.	AC Line Connection	2-1
	2-16.	Printer Paper Installation	2-5
	2-18.	Printer Ribbon Installation	2-6
	2-20.	Option Information	2-6
	2-22.	Scanner Extension	2-6
	2-25.	Internal Switch Settings	2-7
	2-27.	Individual/Block Mode	2-7
	2-30.	Temperature Scale, °C/°F	2-7
	2-32.	Measurement Speed, Fast/Slow	2-7
	2-34.	Print/Record Format	2-7
	2-38.	Program Memory	2-8
	2-40.	Programmable Limits	2-8
	2-45.	Scan Control	2-8
	2-49.	Improper Program Data	2-9
	2-51.	Program List	2-9
	2-53.	System Self Check	2-11
	2-55.	OPERATION	2-11
	2-56.	Turn-On Procedure	2-11
	2-58.	Turn-Off Procedure	2-11
	2-60.	Entering Program Data	2-11
3	**THEORY OF OPERATION**		**3-1**
	3-1.	INTROUCTION	3-1
	3-3.	OVERALL FUNCTIONAL DESCRIPTION	3-1
	3-11.	BLOCK DIAGRAM DESCRIPTION	3-3
	3-12.	Introduction	3-3
	3-14.	Controller PCB Assembly	3-3

(continued page ii)

TABLE OF CONTENTS, *continued*

SECTION TITLE PAGE

3-33. Basic Programmer PCB Assembly 3-5
3-34. Program Memory 3-6
3-40. Mode Switch PCB Assembly 3-7
3-46. Display PCB Assembly 3-8
3-50. Printer Drive PCB Assembly 3-9
3-57. Power Supply PCB Assembly 3-11
3-63. Guard Crossing PCB Assembly 3-12
3-71. A/D Converter PCB Assembly 3-12
3-92. Temperature and Scaling Circuit 3-18
3-95. Temperature Measurement PCB Assembly 3-20
3-100. Low Level Scanner 3-20
3-102. Isothermal Block Connector 3-20

4 **MAINTENANCE** 4-1

4-1. INTRODUCTION 4-1
4-3. SERVICE INFORMATION 4-1
4-6. GENERAL INFORMATION 4-1
4-7. Access Information 4-1
4-17. Cleaning 4-3
4-23. Lubrication 4-4
4-25. Internal Switch Settings 4-4
4-37. Fuse Replacement 4-6
4-39. Service Tools 4-6
4-42. PERFORMANCE TEST 4-6
4-44. Set-Up Procedure 4-6
4-46. Channel Display Test 4-7
4-48. Data Display Test 4-7
4-50. Scan Control Test 4-7
4-52. A/D Converter Accuracy Test 4-8
4-54. CALIBRATION ADJUSTMENTS 4-8
4-56. Initial Procedure 4-8
4-57. Power Supply 4-8
4-59. A/D Converter 4-9
4-61. Isothermal Block Connector 4-10
4-63. TROUBLESHOOTING 4-10

5 **LISTS OF REPLACEABLE PARTS** 5-1

TABLE OF CONTENTS 5-1

5-1. INTRODUCTION 5-2
5-4. HOW TO OBTAIN PARTS 5-2

6 **OPTION AND ACCESSORY INFORMATION** 6-1

TABLE OF CONTENTS 6-1

7 **GENERAL INFORMATION** 7-1

7A **MANUAL CHANGE INFORMATION** 7A-1

8 **SCHEMATIC DIAGRAMS** 8-1

TABLE OF CONTENTS 8-1

List of Tables

List of Tables

TABLE	TITLE	PAGE
1-1.	2200B Option Information	1-2
1-2.	Description of -12, -13 and -14 Series Options	1-3
1-3.	2200B Accessories	1-4
1-4.	2200B Specifications	1-4
2-1.	Controls, Indicators and Connectors	2-3
2-2.	Internal Switch Information	2-7
3-1.	Control Bus Address Codes	3-2
3-2.	Display LED Addresses and Functions	3-9
3-3.	Guard Crossing Signal Descriptions	3-17
3-4.	Input Filter Capacitors	3-18
3-5.	Definition of Configuration PROM Address Codes and Output Codes	3-19
4-1.	Test Equipment Required	4-1
4-2.	A/D Converter Accuracy Test Specifications	4-8
4-3.	Troubleshooting Guide	4-11

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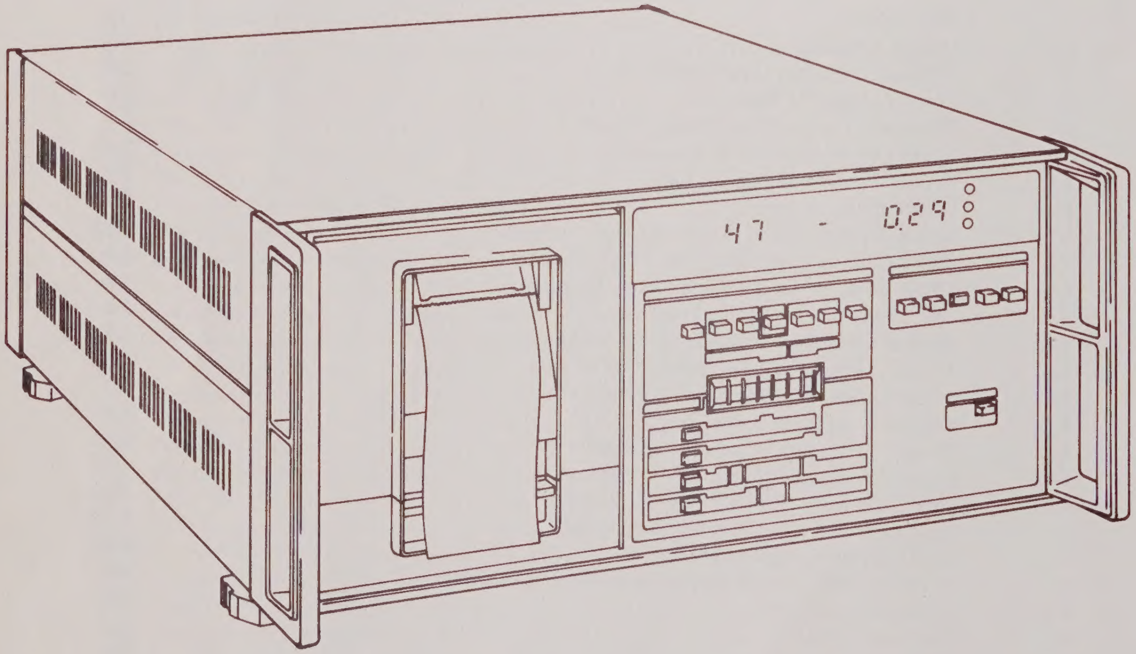
List of Illustrations

FIGURE	TITLE	PAGE
	Frontispiece	*vi*
1-1.	Outline Drawing	1-9
2-1.	Controls, Indicators and Connectors	2-2
2-2.	Properly Installed Ribbon	2-6
2-3.	Threading Direction for Ribbon Spools	2-6
2-4.	2200B Option Installation Locations	2-6
2-5.	Typical Format of Printed Data	2-8
2-6.	Program List of Examples	2-10
2-7.	2200B Program Form, Recommended Format	2-12
3-1.	2200B Data Logger, Simplified Block Diagram	3-1
3-2.	2200B Data Logger Detailed Block Diagram	3-4
3-3.	Two Phase Clock, Timing Diagram	3-5
3-4.	Basic Programmer Simplified Block Diagram	3-5
3-5.	Program Memory Simplified Block Diagram	3-6
3-6.	Mode Switch, Simplified Block Diagram	3-7
3-7.	Display, Simplified Block Diagram	3-8
3-8.	Printer Drive, Simplified Block Diagram	3-10
3-9.	Power Supply, Simplified Block Diagram	3-11
3-10.	Guard Crossing, Simplified Block Diagram	3-13
3-11.	A/D Converter, Function Block Diagram	3-15
3-12.	A/D Converter, Timing Diagram	3-16
4-1.	A/D Converter Test Point and Adjustment Locations	4-2
4-2.	Access Information	4-2
4-3.	Lubrication Chart	4-5
4-4.	2200B Test Cable	4-6
4-5.	Power Supply Test Point and Adjustment Locations	4-8



2200B Data Logger

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Fluke Model 2200B Data Logger is a 10-channel, programmable data logger which is expandable, through the use of optional plug-in modules, into a user-designed data acquisition system capable of servicing up to 100 channels of guarded analog data. Basically, the unit is designed to scan and measure analog input data, and then output the measurement data in digital form. Output data is displayed and can be recorded, if desired, on an internal line printer or an optional output device.

1-3. Functionally, the 2200B can be divided into three sections: input, control and output. The input section is designed to physically house a series of relay scanners. Analog input data is processed through these scanners and measured by an A/D Converter. The control section operates under program control to select input data channels, and scale the resultant measurement readings for display or recording purposes. The output section displays all progamming and measurement data. It also outputs data by way of the internal printer and/or optional output devices when commanded.

1-4. The input section consists of a series of six input-scanner/input-connector slots and a high performance A/D Converter. A single 10-channel relay scanner and input connector are supplied with the 2200B. Up to five additional scanners can be installed in the remaining slots for a total of 60 channels. When more than 60 channels are required, the input section can be expanded to accomodate 100 channels by way of an add-on extender chassis (Model 2201A, 2202A or 2203A). Available input scanners and input connectors include those listed in Table 1-1. They are supplied as options and each is described in Section 6 of this manual.

1-5. Analog data present at a selected channel is measured by a multi-range, dual-slope, high-performance A/D Converter. Selectable ranges include: 40V dc, 4V dc, 400 mV dc, 40 mV dc and up to four custom scaled functions. Typical scales include thermocouple linearization, RTD scaling and other transducer data conversion for direct readout in engineering units. Custom scaling is not an integral part of the input section, but rather, is part of the control section.

1-6. The analog portion of the A/D Converter and the entire input section is electrically isolated from the control and output sections of the 2200B. This effectively guards and isolates the input signals from the influence of other system grounds and I/O signals.

1-7. The control section of the 2200B features all of the controls and logic necessary to operate the unit with a full complement of options. The controls are divided into three groups: SCAN CONTROL, OUTPUT CONTROL and PROGRAMMING. An actual data sequence (scan mode) is both selected and initiated by depressing one of the switches in the SCAN CONTROL group; SINGLE, INTERVAL, MONITOR or CONTINUOUS. Measurement data taken during a scan sequence is displayed after each channel is measured, and then output for recording purposes, in accordance with the OUTPUT CONTROL switch setting; PROGRAM LIST, ALL DATA, ALARM DATA, EXTERNAL (recorder) ON. Output control is disabled when none of its switches are depressed. In that event, data is displayed on the front panel, but not recorded.

Table 1-1. 2200B Option Information

FUNCTION	OPTION #	DESCRIPTION	QUANTITY USED IN 2200B		FACTORY OR SERVICE CENTER INSTALLATION REQUIRED?
			MAX	MIN	
Input Connectors	–03 –07 –08	RTD Connector Solder Pin Connector Isothermal Block Connector	6	1	*No
Scanners	–05 –06 –33	General Purpose Scanner Low Level Scanner RTD Scanner	6	1	*No
Alarms	–23	Alarm Set Point, Output	1	0	*No
	–34	Alarm Set Point	1	0	Yes
Scaling and Linearization	–27 –26	Engineering Units Notation Multiple Scaling	1	0	Yes
Digital Input Interface	–16	Digital Input Interface	3	0	*No
Digital Output Interface Series (see Table 1-2)	–12 –13 –14	TTY RS-232C Interface Paper Punch Interface Magnetic Tape Interface			

* Customer can install.

1-8. The particulars of a scan sequence are determined by entering a series of data words using the PROGRAMMING switches. Each word is set on a series of thumbwheel switches and then entered into memory by pressing the appropriate function switch. Available functions include:

1. First and last channel assignment.
2. Single channel selection.
3. Channel measurement-function assignments.
4. Channel measurement-limit assignments.
5. Enter time-of-day and interval time.

1-9. The output section of the 2200B includes the front panel digital display, a 16-column line printer and three pcb slots for installing up to three of the input/output (I/O) interface options listed in Table 1-1. The I/O options are described in detail in Section 6 of this manual.

1-10. The digital display is actually two separate displays which are used for visually presenting both program and measurement data. Display data includes a two digit channel identifier and the measurement data for that channel (polarity plus five digits and a decimal point). During a normal scan sequence, the channel identifier is incrementally advanced as each channel measurement is completed, and continues to advance until the last selected channel (00 up to 99) is scanned. A series of annunciators complement the display and indicate the selected measurement function (volts, millivolts, temperature) for the channel indicated.

1-11. The printer employed in the 2200B is the Seiko Model 102. It is a medium-speed, ink-impression, line printer capable of recording data at a maximum rate of 2.5 lines per second. Sixteen columns of data are available. However, the print format for a scan sequence is fixed, as described in Section 2. Ordinary 2-1/4 inch fan-fold adding machine paper is used as the recoding medium. A front panel drawer is provided for both housing and take-up of the self-stacking fan-fold paper.

1-12. The power supply provided with the 2200B is capable of servicing both the basic unit and a full complement of options. Available input power configurations include 100 or 115/230V ac ±10%, 50 or

60 Hz, 50 watts maximum. Switches are provided on the power supply for selecting the proper line voltage and/or frequency. The line power requirement should be specified at time of purchase.

1-13. Several option and accessories are available for use with the 2200B. The options, their quantity limitations and their installation requirements (factory or field) are listed in Table 1-1. Table 1-2 provides a description of the suboptions included in the -12, -13 and -14 Series of options, and Table 1-3 describes the available 2200B Accessories. Decriptions of the accessories (all except 2201A, 2202A and 2203A) are included in Section 6 of this manual. Descriptions of the options and some accessories are supplied separately (when the option or accessory is purchased), and most are designed as subsectional inserts for Section 6 of this manual The 2201A, 2202A and 2203A series of scanner chassis are documented in separate stand-alone instruction manuals.

1-14. SPECIFICATIONS

1-15. Specifications for the Model 2200B Data Logger are contained in Table 1-4.

Table 1-2. Description of −12, −13 and −14 Series Options

OPTION NO.	DESCRIPTION	RECORDER TYPE	OPTION CONFIGURATION		
			RECORDER	CABLE	INTERFACE PCB
−12B	ASR33 Interface	Teleprinter (20 mA)	○	●	●
−12C	TI733 KSR/RO Interface	Teleprinter	○	●	●
−12L	RS-232C Interface	Teleprinter	○	●	●
−12M	RS-232C Interface	Modem	○	●	●
−12N	Tektronix 4923 and Interface	Mag Tape	●	●	●
−13A	Facit 4070 (Bench Top) and Interface	Paper Tape Punch	●	●	●
−13B	Facit 4070 (Rack Mounted) and Interface		●	●	●
−13C	Facit 4070 Interface		○	●	●
−13D	Facit 4203.0005 and Interface	Cassette	●	●	●
−13E	Facit 4203.0005 Interface		○	●	●
−14A	Kennedy 1600/5 and Interface	Mag Tape	●	●	●
−14B	Kennedy 1610/5 and Interface		●	●	●
−14C	Kennedy 1600/360 and Interface		●	●	●
−14D	Kennedy 1610/360 and Interface		●	●	●
−14E	Kennedy 1600/5 or 1610/5 Interface		○	●	●
−14G	Kennedy 1600/360 or 1610/360 Interface		○	●	●
−14H	Kennedy 9832-7 and Interface		●	●	●
−14I	Kennedy 9832-7 Interface		○	●	●
−14J	Kennedy 9832-9 and Interface		●	●	●
−14K	Kennedy 9832-9 Interface		○	●	●

Table 1-3. 2200B Accessories

MODEL NO.	DESCRIPTION	FUNCTION
2201A	Scanner Chassis	Houses up to twelve scanners. (2200B reads up to 10 scanners) Operates up to 50 feet from 2200B.
2202A	Remote Scanner Chassis	Houses up to ten scanners. Operates up to 1500 feet from 2200B.
2203A	RTD Scanner Chassis	Houses up to ten scanners. Operates up to 1500 feet from the 2200B.
2200A-7007	Interface Connector, Blank (50-pin)	I/O connector for use with Option –16.
2200A-7006	General Purpose Interface Cable (6 feet)	I/O connector and cable for use with Option –16. (connector on one end only.)
2200A-7005	Service Extender Cable Set	Extends most 2200B pcb's for servicing.
M07-205-600	Rack Mounting Kit	Rack mounts 2200B in 19" wide console.
M00-280-610	Rack Slide Kit, 24" Cabinet	Slide mounts 2200B in 19" (W) x 24" (D) console.
2010A-7013	Fan-Fold Printer Paper (1 dozen)	Replacement printer paper.
2010A-7014	Printer Ribbon (1 dozen)	Replacement printer ribbon.

Table 1-4. 2200B Specifications

INPUT	
System Accuracy*	
90 Days (20°C to 30°C)	±(0.01% reading + 0.005% range + 3 µV) slow speed ±(0.01% reading + 0.008% range + 5 µV) fast speed
1 Year (15°C to 35°C)	±(0.02% reading + 0.01% range + 5 µV) slow speed ±(0.02% reading + 0.015% range + 7 µV) fast speed
** System accuracy includes all instrument errors such as a-d errors, scanner errors, power supply, internal warmup, etc.*	
Common Mode Rejection	140 dB at 50 and 60 Hz ±0.1%, 120 dB at dc with 1 kΩ unbalance at slow speed 110 dB at 50 and 60 Hz ±0.1%, 120 dB at dc with 1 kΩ unbalance at fast speed
Common Mode Voltage	Maximum of 350V dc or peak ac
Normal Mode Rejection	70 dB at 50 and 60 Hz ±0.1% slow speed 55 dB at 50 and 60 Hz ±0.1% fast speed
Temperature Coefficient (0°C to 20°C and 30°C to 50°C)	±(0.001% reading + 0.001% range)/°C
Channel Capacity	60 channels, expandable to 100 channels, using the Model 2201A, 2202A or 2203A Scanner Extender chassis
Input Scanner	One 10-channel Low Level Scanner (Option –06) is included with the basic 2200B. See Option Specifications.
Input Connector	One Isothermal Block Connector (Option –08) is included with the basic 2200B. See Option Specifications.

Table 1-4. 2200B Specifications (cont)

A/D Converter	
Measurement Method	Dual slope integration over 5 line cycles (slow speed) or 1 line cycle (fast speed)
Measurement Speed	3 readings per sec with integration over 5 line cycles (slow speed) 15 readings per sec with integration over 1 line cycle (fast speed) Selectable by internal switch
Dynamic Range	40,000 counts (0-39,999)
Ranges	±40 mV (1 μV resolution) ±400 mV (10 μV resolution) ±4V (100 μV resolution) ±40V (1 mV resolution)
Zero Stability	Automatic zero
Overload without Damage	170V dc or peak ac any range
Overrange Indication	Front panel display, printer and output indicate overrange
Input Impedance	>200 MΩ on all ranges except 40V range; input impedance is 10 MΩ on 40V range. Source impedance must be <4 kΩ to incur no settling errors, except the 40V range which has no limitation for settling errors. See Figure 1.

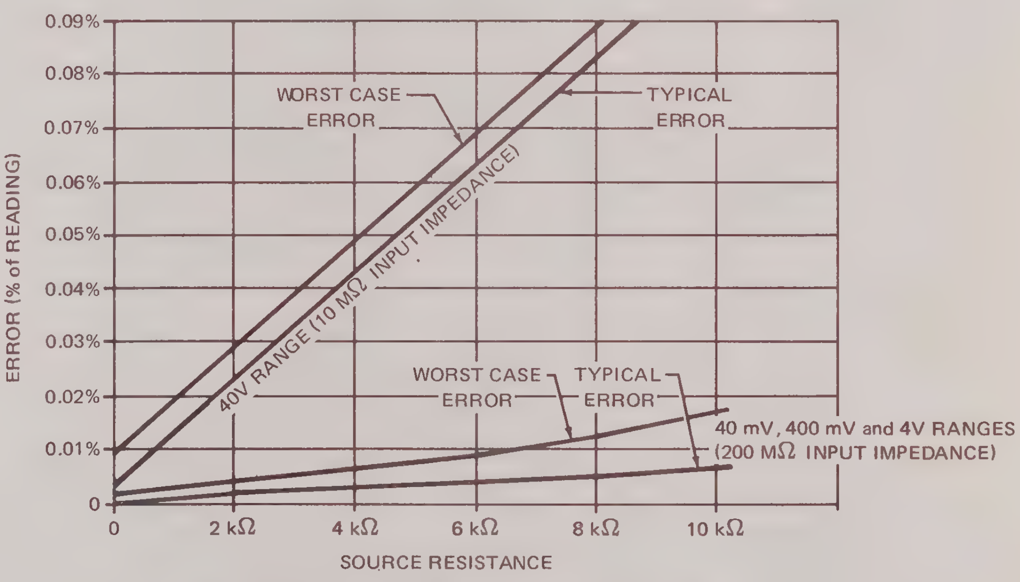


Figure 1. Error (% of Reading) versus Source Resistance

Reference Voltages	2V and .02V at rear panel jacks
Reference Accuracy	90 Days, 20°C–30°C ±0.02%
Reference Stability	±0.003%/°C ±0.003%/Yr
Input Guarding	Total isolation of analog inputs between other analog inputs, ground, digital inputs and digital logic is provided by continuous guard shield. The entire analog signal path is enclosed in an isolated, guarded enclosure.

Table 1-4. 2200B Specifications (cont)

Temperature Measurements

System Accuracy (not including sensor errors)	
Thermocouples	See Table 1
RTD's	See Table 2
Compatible Probe Types	J, K, T, R, S, E, B, C, G, D, (W3), RTD (385 platinum), RTD (392 platinum) and current transmitter (1-5 mA, 4-20 mA and 10 to 50 mA) reading 0 to 100%. Connector –28, –29 or –30 required with current transmitter
Linearization	Digital, 31 to 33 optimized segment lengths
Open Circuit Detection	Source impedance of greater than 7.5k ±2.5 kΩ and capacitance ≤0.01 μF is defined as an open circuit.
Open Circuit Indication	Front panel display, printer and all serial output devices provide open circuit indications
Temperature Scale Selection	Switch is provided on the inside of the 2200B for selecting either the °C or °F temperature scale for measurement, display and recording purposes
Reference Junction Compensation	Automatic from 0° to +50°C. (Less than ±0.05° error from 15 to 35°C for J, K and T type thermocouples.)
Resolution Linearization	Temperature resolution
Temperature Coefficient (0 to 20°C and 30 to 50°C)	±(0.0015% of reading +0.01°)/°C

Table 1. System Accuracy, Thermocouple Measurements

TEMPERATURE RANGE AND THERMOCOUPLE TYPE	WORST CASE RESOLUTION	NBS CONFORMITY	SYSTEM ACCURACY (±)		
			90 DAYS 77°F ±9°F 25°C ±5°C SLOW[2]	FAST[3]	1 YEAR 77°F ±18°F 25°C ±10°C SLOW[2]
J Iron-Constantan					
°F -332 to -200	0.2°	0.15°	1.0°	1.2°	1.2°
-200 to 32	0.1°	0.15°	0.8°	0.9°	1.0°
32 to 1400	0.1°	0.1°	0.8°	0.7°	0.7°
1400 to 2200	0.1°	0.3°	0.8°	0.9°	1.0°
°C -202 to 0	0.1°	0.083°	0.6°	0.7°	0.7°
0 to 760	0.1°	0.055°	0.4°	0.5°	0.5°
760 to 1205	0.1°	0.166°	0.5°	0.6°	0.6°
K Chromel-Alumel					
°F -332 to -300	0.3°	0.175°	1.2°	1.4°	1.5°
-300 to -200	0.2°	0.175°	1.0°	1.2°	1.3°
-200 to 32	0.2°	0.175°	0.8°	1.0°	1.1°
32 to 500	0.1°	0.15°	0.7°	0.8°	0.8°
500 to 2500	0.1°	0.15°	0.8°	0.9°	1.0°
°C -202 to -172	0.2°	0.1°	0.7°	0.8°	0.9°
-172 to -130	0.1°	0.1°	0.6°	0.7°	0.8°
-130 to 0	0.1°	0.1°	0.5°	0.6°	0.6°
0 to 260	0.1°	0.083°	0.4°	0.5°	0.5°
260 to 1370	0.1°	0.083°	0.5°	0.6°	0.6°
T Copper-Constantan					
°F -332 to -300	0.2°	0.1°	1.0°	1.4°	1.5°
-300 to -200	0.1°	0.1°	0.9°	1.2°	1.3°
-200 to 32	0.1°	0.1°	0.8°	1.0°	1.1°
32 to 750	0.1°	0.1°	0.6°	0.7°	0.8°
°C -202 to -130	0.1°	0.055°	0.6°	0.8°	0.8°
-130 to 0	0.1°	0.055°	0.5°	0.6°	0.7°
0 to 400	0.1°	0.055°	0.4°	0.5°	0.5°

Table 1-4. 2200B Specifications (cont)

Table 1. System Accuracy, Thermocouple Measurements (cont)

TEMPERATURE RANGE AND THERMOCOUPLE TYPE	WORST CASE RESOLUTION	NBS CONFORMITY	SYSTEM ACCURACY (±)		
			90 DAYS 77°F ±9°F 25°C ±5°C		1 YEAR 77°F ± 18°F 25°C ± 10°C
			SLOW[2]	FAST[3]	SLOW[2]
E Chromel-Constantan					
°F -332 to -240	0.2°	0.175°	0.9°	1.0°	1.1°
-240 to 32	0.1°	0.175°	0.8°	0.9°	1.0°
32 to 500	0.1°	0.11°	0.6°	0.7°	0.7°
500 to 1830	0.1°	0.11°	0.6°	0.7°	0.7°
°C -202 to 0	0.1°	0.1°	0.5°	0.6°	0.6°
0 to 260	0.1°	0.1°	0.4°	0.5°	0.5°
260 to 960	0.1°	0.07°	0.4°	0.5°	0.5°
R Pt. 13% Rhodium					
°F 32 to 90	0.4°	0.2°	2.8°	3.6°	3.6°
90 to 500	0.3°	0.2°	2.4°	3.2°	3.2°
500 to 3200	0.2°	0.2°	1.6°	2.2°	2.4°
°C 0 to 260	0.2°	0.1°	1.5°	2.2°	2.2°
260 to 350	0.2°	0.1°	1.0°	1.2°	1.4°
350 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°
S Pt. 10% Rhodium					
°F 32 to 90	0.4°	0.2°	2.8°	3.6°	3.6°
90 to 500	0.3°	0.2°	2.4°	3.2°	3.2°
500 to 3200	0.2°	0.2°	1.6°	2.2°	2.4°
°C 0 to 260	0.2°	0.1°	1.5°	2.2°	2.2°
260 to 550	0.2°	0.1°	1.0°	1.2°	1.4°
550 to 1760	0.1°	0.1°	1.0°	1.4°	1.4°
B Pt. 6% Rhodium versus Pt. 30% Rhodium					
°F 896 to 1800	0.3°	0.14°	2.6°	3.6°	3.6°
1800 to 3308	0.2°	0.14°	2.0°	2.6°	2.6°
°C 480 to 1000	0.2°	0.08°	1.6°	2.4°	2.4°
1000 to 1820	0.1°	0.08°	1.2°	1.6°	1.6°
C[1] Tungsten 5% Rhenium versus Tungsten 26% Rhenium					
°F 32 to 3632	0.2°	0.18°	1.2°	1.6°	1.6°
3632 to 4208	0.2°	13.5°	15.0°	16.0°	16.0°
°C 0 to 2000	0.1°	0.1°	0.7°	1.0°	1.0°
2000 to 2320	0.1°	7.5°	9.0°	9.5°	9.5°
D[1] (W3)[1] Tungsten 3% Rhenium versus Tungsten 25% Rhenium					
°F 32 to 500	0.2°	0.22°	1.4°	1.8°	1.8°
500 to 3632	0.2°	0.22°	1.2°	1.6°	1.6°
3632 to 4208	0.2°	18.4°	20.0°	21.0°	21.0°
°C 0 to 260	0.1°	0.12°	0.8°	1.0°	1.0°
260 to 2000	0.1°	0.12°	0.7°	1.0°	1.0°
2000 to 2320	0.1°	10.2°	12.0°	12.5°	12.5°
G[1] Tungsten versus Tungsten 26% Rhenium					
°F 410 to 800	0.2°	0.2°	1.6°	2.2°	2.2°
800 to 3632	0.2°	0.2°	1.4°	1.8°	1.8°
3632 to 4208	0.2°	13.8°	15.0°	16.0°	16.0°
°C 210 to 420	0.2°	0.12°	1.0°	1.4°	1.4°
420 to 2000	0.1°	0.12°	0.8°	1.0°	1.2°
2000 to 2320	0.1°	7.1°	8.0°	8.5°	8.5°

[1] *Not ANSI Symbol*

[2] *Slow Speed - 2.5 readings/sec*

[3] *Fast Speed - 15 readings/sec*

Table 1-4. 2200B Specifications (cont)

Table 2. System Accuracy, RTD Measurements

TEMPERATURE RANGE	RESOLUTION	LINEARIZATION CONFORMITY	90 DAY 25 ±5°C		1 YEAR 25 ± 10°C SLOW
			SLOW	FAST	
−200°C to +450°C	0.1°	0.035°	0.3°C	0.4°C	0.4°C
+450°C to +775°C			0.4°C	0.5°C	0.5°C
−328°F to +700°F			0.5°F	0.6°F	0.6°F
+700°F to +1427°F	0.1°	0.063°	0.7°F	0.8°F	0.7°F

RTD's (Ice Point Resistance: 100Ω ±0.8%; α = 385 or 392).

CONTROL

Scan Interval	1 min to 23 hrs and 59 min
Clock	23 hrs: 59 min: 59 sec. Line frequency
Programming	Convenient thumbwheel switches provide easy input. Non-volatile memory retains settings even when power is removed up to 5 years. Channel or block programming is switch selectable.
Alarms	4 set points per block assignable as all high, all low or any combination high or low. 40 set points total.
Channel/Block	Switch selectable allows programming in 10 channel blocks or individually for channels 0-9.
Program List	Complete listing of function limits and interval for each channel/block.
Program Protection	Five year non-volatile memory, maintains program when power is removed.
Linearization	Digital linearizations are stored in PROM memory for maximum reliability. All linearizations are digital for high accuracy.
Scaling	Inclusion of −26 Multiple Scaling Option provides up to 4 preselected Ax + B scaling functions. Each function is selectable from the front panel.
Units	Units are indicated on printout and on front display (temp., volts, mV). Printer prints °F, °C, mV, V. Other units are available using Option −27.
Digital Input Option	Requires one I/O slot per card.
Configuration	One channel per card: each channel −9 digits, fully buffered.
Electrical	TTL logic levels; Logic 1 ⩾4V DC; Logic 0 ⩽0.5V DC; load pulse loads data in buffer for input. Loads on negative edge. Busy pulse out advises when card is being read. Up to 3 inputs.
I/O Slots	3 standard

OUTPUT

Printer	On board digital printer. Standard 16-column with data, and units printout. 2.5 lines/sec.
Options	See Table 1-2.

Table 1-4. 2200B Specifications (cont)

GENERAL	
Dimensions	7 in. High X 17 in. wide X 22.47 in. deep (17.78 cm X 43.18 cm X 57.1 cm) See outline drawing in Figure 1-1
Weight	Approximately 40 pounds without options (18.144 kg)
Power	Specify one of the following combinations at time of purchase: (50 watts maximum) 100V ac ±10%, 50 Hz 100V ac ±10%, 60 Hz 115/230V ac ±10%, 50 Hz 115/230V ac ±10%, 60 Hz
Warmup Time	One hour for full accuracy. Accuracy is reduced by 0.02% of range at time of the initial turn-on.
ENVIRONMENTAL	
Temperature	
Operating	0°C to +50°C
Storage	−40°C to +60°C
Humidity	80% relative humidity, non-condensing, 0 to +35°C 70% relative humidity, non-condensing, +35 to +50°C
Shock and Vibration	Meets MIL-T-28800A, Class 4

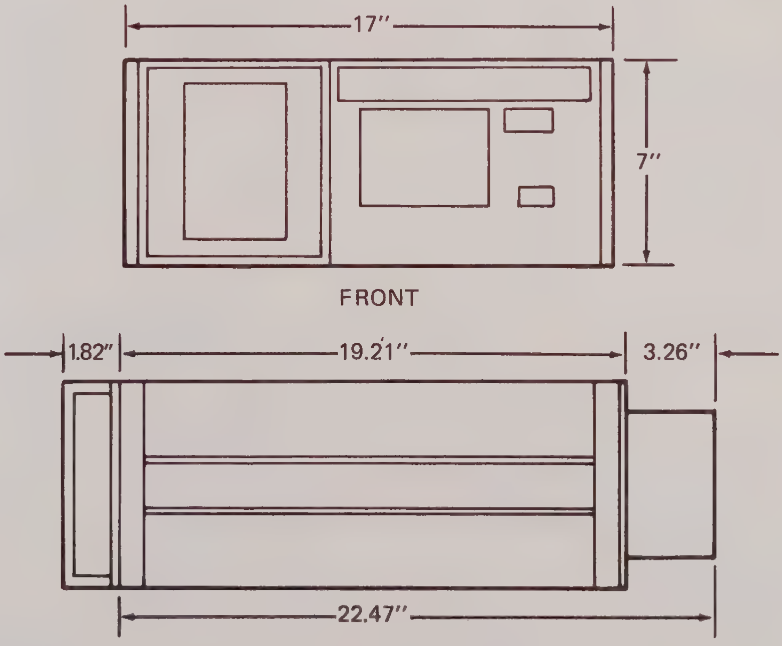
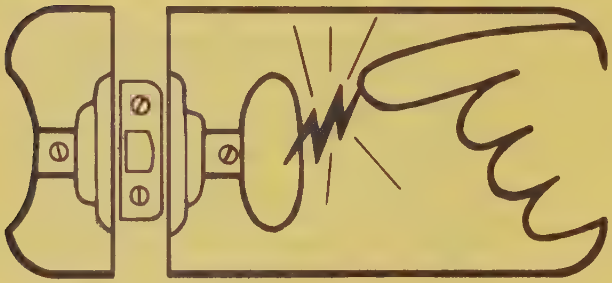


Figure 1-1. Outline Drawing

static awareness

A Message From

John Fluke Mfg. Co., Inc.



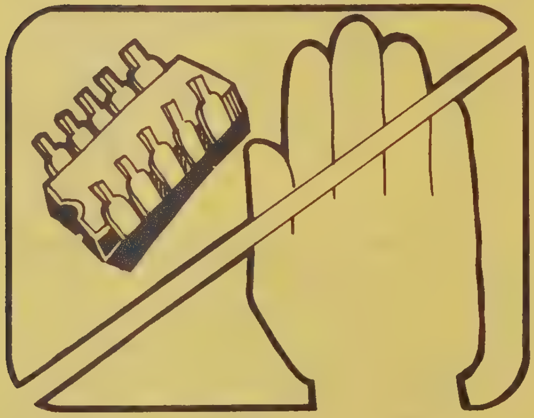
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

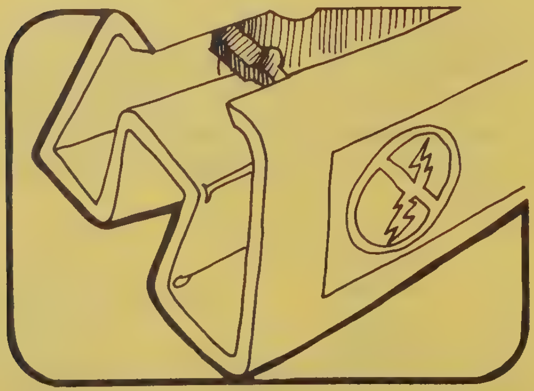
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol

" ⊗ "

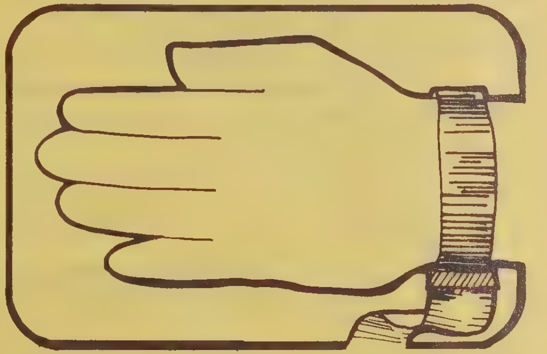
The following practices should be followed to minimize damage to S.S. devices.



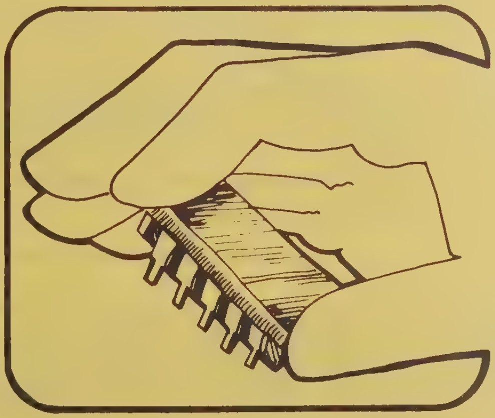
1. MINIMIZE HANDLING



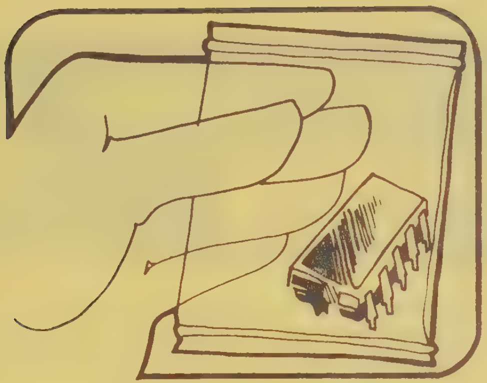
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



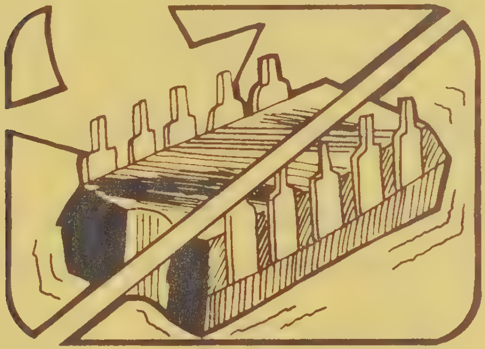
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



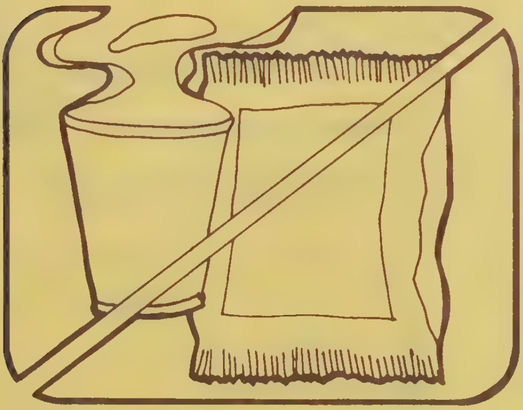
4. HANDLE S.S. DEVICES BY THE BODY



5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT

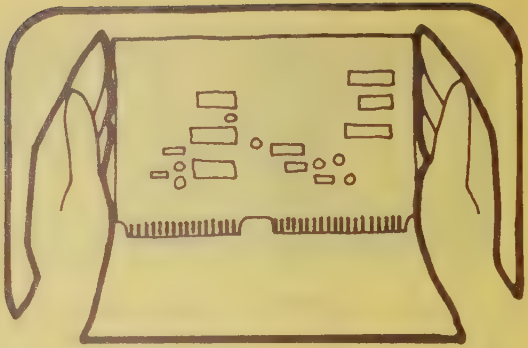


6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE

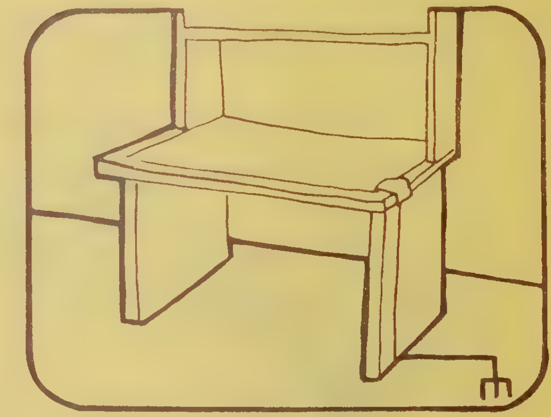


7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA

PORTIONS REPRINTED
WITH PERMISSION FROM TEKTRONIX, INC.
AND GENERAL DYNAMICS, POMONA DIV.



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR USUALLY PROVIDES COMPLETE PROTECTION TO INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Description
453522	6" X 8" Bag
453530	8" X 12" Bag
453548	16" X 24" Bag
454025	12" X 15" Bag
Pink Poly Sheet	Wrist Strap
30"x60"x60 Mil	P/N TL6-60
P/N RC-AS-1200	$7.00
$20.00	

® Dow Chemical

Section 2

Operating Instructions

2-1. INTRODUCTION

2-2. This section of the manual contains information concerning the installation and operation of the Model 2200B Data Logger. It is recommended that the contents of this section be read and understood before any attempt is made to operate the unit. Should any difficulties arise during operation, contact your nearest John Fluke Sales Representative, or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of sales representatives is given in Section 7.

2-3. SHIPPING INFORMATION

2-4. The 2200B is packaged and shipped in a foam-packed container. Upon receipt of the instrument, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included on the shipping carton.

2-5. If reshipment of the instrument is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the instrument's model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The 2200B can be operated from either 100, or 115/230V; 50 or 60 Hz line power depending upon the combination specified at the time of purchase. Check the rear panel decal for the voltage and frequency selected prior to shipment. If a change in either is required refer to Section 4 of this manual for the proper selection procedures.

2-8. RACK INSTALLATION

2-9. The 2200B is designed for either bench-top use or for installation in a standard 19-inch equipment rack using the accessory Rack Mounting Kit (John Fluke P/N M07-205-600). Chassis slides (John Fluke P/N M00-280-610) can also be installed to facilitate access to the instrument when it is installed in an equipment rack. Information regarding the installation of the rack-mounting accessories in included in Section 6.

2-10. OPERATING FEATURES

2-11. The function and location of all 2200B controls, indicators and connectors are shown in Figure 2-1 and described in Table 2-1.

2-12. OPERATING NOTES

2-13. The following paragraphs describe the various conditions which should be considered before operating the 2200B.

2-14. AC Line Connection

2-15. The rear-panel three-prong, U-ground connector permits the 2200B to be connected, through a power cord, to either 100, 115/230V ac, 50 or 60 Hz line power. The offset prong on this connector is connected to the 2200B chassis and should be connected, via the power cord, to a high-quality earth ground.

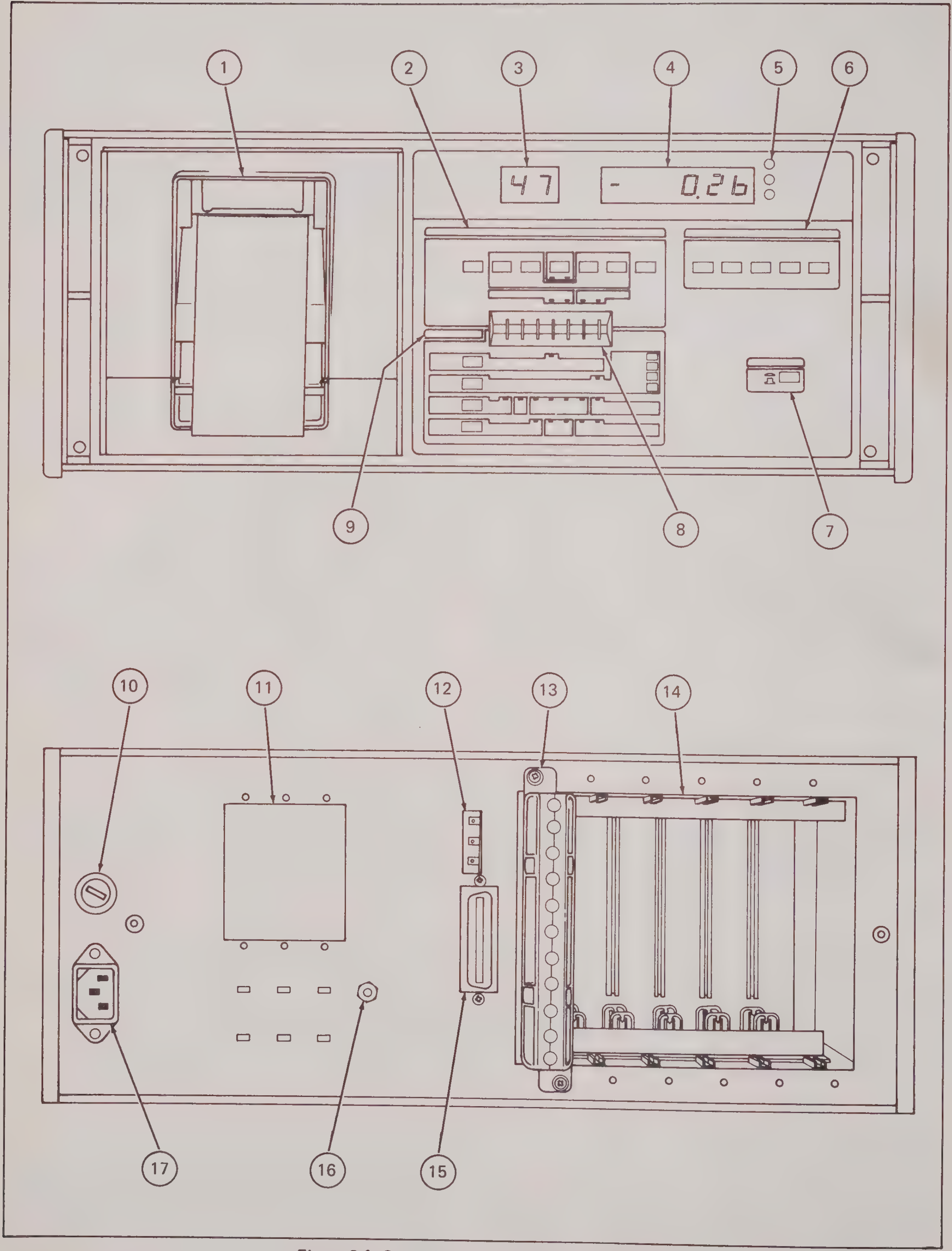

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Figure 2-1. Controls, Indicators and Connectors

Table 2-1. Controls, Indicators and Connectors

REF. NO.	NAME	FUNCTION
1	Printer	Seiko Model 102 line printer used to provide hard copy records of program data and/or measurement data. The printer function is determined by the switch settings in the OUTPUT CONTROL switch group.
2	SCAN CONTROL Switches	Seven pushbutton switches, six of which are interlocked. The seventh, ALARM RESET, operates independently. The interlocked switches are used to select the 2200B scan mode. RESET/PROGRAM Terminates any previously selected scan control sequence ~~and~~ and enables the programming mode. SINGLE Initiates the single scan control mode, i.e., one scan of the first through last channel is executed. (The first and last channels are determined by the thumbwheel switch settings.) INTERVAL Initiates a single scan sequence when the switch is depressed. The sequence is restarted at the end of the programmed interval time. This pattern is repeated until the scan control mode is changed. MONITOR Causes the monitor channel set on the thumbwheel switch to be repeatedly measured and displayed. CONTINUOUS Initiates a continuously repeated scan sequence. All selected channels (first to last) are measured and displayed. REMOTE Operates in conjunction with any one of the output options (-12, -13 or -14 Series) to enable the remote start of a single scan sequence. ALARM RESET When depressed, this switch turns off all outputs on the Alarm Set Point Option (-23).
3	CHANNEL Display	A two-digit display which provides a readout of the channel being measured or programmed, 00 to 99.
4	DATA Display	A six-digit display which provides a readout of the data being measured (millivolts, volts or temperature) at the displayed channel.
5	Data Annunciator	Three LED's which light on a mutually exclusive basis to indicate the measurement function assigned to the displayed channel, MILLIVOLTS, VOLTS or TEMPERATURE.
6	OUTPUT CONTROL Switches	Five pushbutton switches used to enable/disable the operation of the printer and/or any external peripheral recorders that may be interfaced with the 2200B. PROGRAM LIST When pressed causes a printout of all limits data and the first through last channel data in program memory. To enable program list both the RESET/PROGRAM switch (SCAN CONTROL) and the ALL DATA switch (OUTPUT CONTROL) must be depressed.

Table 2-1. Controls, Indicators and Connectors (cont)

REF. NO.	NAME	FUNCTION
		PAPER ADVANCE A momentary switch used to manually advance paper through the printer. ALL DATA When depressed causes the printer to record all measurement data and when commanded, list the program data. ALARM DATA When depressed causes the printer to print only measurement data that exceeds the assigned limits, if any. EXTERNAL ON When depressed enables peripheral recording devices interfaced with the 2200B to record measurement data.
7	POWER Switch	Switches the 2200B on and off. The unit is on when the switch is depressed.
8	Data Entry and Channel Select Switches	A series of seven thumbwheel switches used to enter programming data (when the RESET/PROGRAM switch is depressed) and select first, last and monitor channels (when a SCAN CONTROL switch other than RESET/PROGRAM or ALARM RESET is depressed).
9	PROGRAMMING Switches	A series of pushbutton switches that are operated in conjunction with the data entry thumbwheel switches to enter program data. RESET/PROGRAM must be depressed before attempting to enter program data. SELECT CHANNEL Pressing this switch causes the channel/block set on the flagged thumbwheel switch to be displayed and selected as the channel/block to receive subsequent function and/or limits data. ENTER FUNCTION Pressing this switch assigns the measurement function set on the flagged thumbwheel switch to the selected channel. Switch Setting = Function 0 Skip 1 40 mV 2 400 mV 3 4V 4 40V 5 T1 6 T2 7 T3 8 T4 ENTER LIMITS When the Alarm Set Point (Option -34) is installed, up to four separate limit values may be assigned to the selected channel/block by using this switch. Sense, polarity and value of each limit is assigned using the thumbwheel switches. Similarly, a thumbwheel switch is used to assign the limit number (1, 2, 3 or 4). ENTER TIME This switch is used to set the 24-hour time-of-day clock or program the interval time for the interval scan control mode. Time is set in hours and minutes, from 00 hours:00 minutes to 23 hours:59 minutes. A thumbwheel switch is used to define a clock assignment (0) or an interval assignment (1).

Table 2-1. Controls, Indicators and Connectors (cont)

REF. NO.	NAME	FUNCTION
10	Fuse	Provides ac input protection from overloads.
11	Option Connector Port	A three connector I/O port that allows electrical access to optional input/output pcb's that may be installed in the 2200B. The connectors are an integral part of the option pcb's.
12	Reference Voltage Connectors	A series of three output connectors that provide user access to two refenence voltage, 2.0 and .02V dc. The third output is reference common. See rear panel cover for connector identification.
13	Scanner and Input Connector	The standard 2200B is supplied with one Low Level Scanner (Option -06) and one Isothermal Block Connector (Option -08) installed in scanner position 0 (Block 0).
14	Scanner Ports	Six pcb slots (Block 0 through Block 5) designed to accommodate a total of six scanner options and their input connectors. One scanner and an input connector are supplied with the basic 2200B.
15	Extender Connector	Provides the electrical connections required to extend the 2200B channel capacity by adding an extender chassis (2201A, 2202A, 2203A).
16	Chassis Ground Connection	This rear panel stud provides a convenient connection to chassis ground.
17	Input Power Connector	A three-prong connector used to connect the instrument (via the line cord) to line power.

2-16. Printer Paper Installation

2-17. Standard 2-1/4 inch fan-fold adding machine tape is used as a recording medium for the printer. A package of fan-fold paper is shipped with the 2200B and should be installed before attempting to operate the unit. Use the following procedure for installing the printer paper:

NOTE

The printer is not designed to accommodate rolled paper tape.

1. Fully extend the tape drawer, raise the panel above the drawer to a horizontal position and pull the paper-cutter bar away from the printer drum.

2. Pick up the paper pack so that the red marking visible on one side of the package, is located on the bottom of the stack (some packs may not have the red markings).

3. Remove the band from the paper and fold-out the top sheet of paper. This provides a leader for loading the tape into the printer mechanism.

4. Hold the pack with the leader on top and pointing away from the printer. Then slide the pack deep into the tape drawer. When properly positioned, the front of the pack should be just behind the front panel.

5. Turn the 2200B on using the procedure given later in this section under Operation.

6. Locate the arrow on the front of the printer mechanism. The arrow points to the paper-feed slot. Hold the paper leader in a horizontal position and insert it as far as possible into the feed slot (approximately 5/8 of an inch). Depress and hold the PAPER ADVANCE switch until 8 to 10 inches of leader have been fed through the printer mechanism.

7. Thread the leader through the paper-cutter bar and press the bar back into position.

8. Thread the leader through the front panel opening and close the panel. Check to ensure that the paper is still free to advance.

9. The tape drawer should be left in the extended position, and used to store the printed tape expelled from the printer. Guide the first two or three folds into position in the drawer.

NOTE

Simplified paper loading instructions are given on a decal located in the bottom of the paper drawer.

2-18. Printer Ribbon Installation

2-19. A printer ribbon is supplied with the 2200B and should be installed before attempting to operate the instrument. The ribbon installation location is accessible by raising the printer's front panel to the horizontal position. If the ribbon is already installed, refer to Figure 2-2 and check to ensure that the ribbon is properly positioned on the feed guides and that the ribbon spools are threaded in the proper direction. Use the following procedure for ribbon installation:

1. Separate the ribbon spools and lay them on a flat surface with their finger-side down.

2. Refer to Figure 2-3 and ensure that the ribbon is properly threaded on the spools.

3. On the printer mechanism, locate and push down the detecting lever on either spool shaft (see Figure 2-2) with the finger-side of either spool pointed toward the printer mechanism, slide the spool onto the shaft.

4. Unwind 6 or 8 inches of ribbon from the remaining spool, if necessary, and position the ribbon over the feed guides as shown in Figure 2-2.

5. Depress the detecting lever on the unused spool shaft and slip the second spool onto the shaft. Make sure that there are no twists in the ribbon.

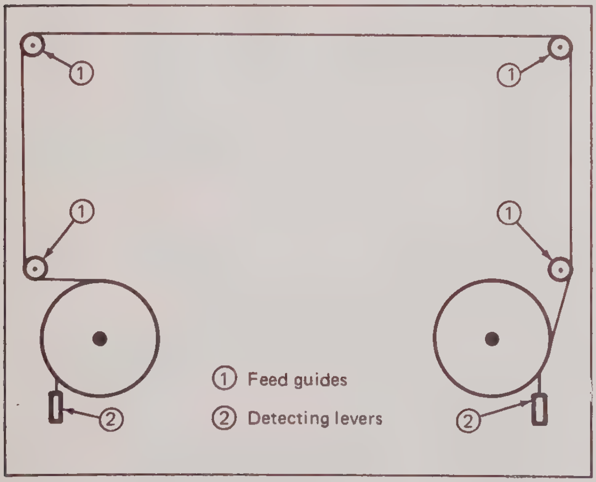


Figure 2-2. Properly Installed Ribbon

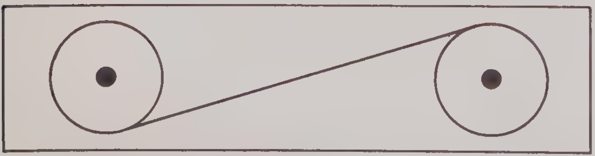
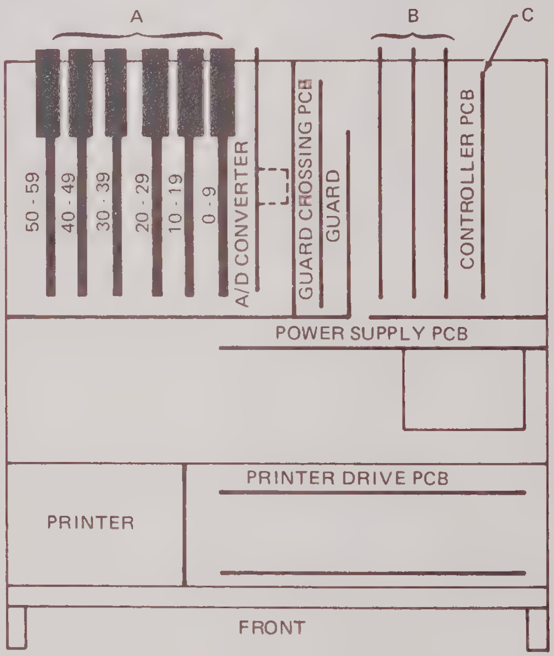


Figure 2-3. Threading Direction for Ribbon Spools

2-20. Option Information

2-21. The front panel operating instructions given in this section of the manual assume that the 2200B contains a full complement of options as shown in Figure 2-4. However, information which is unique to a particular option, such as, description, installation, interface information, maintenance, etc., is contained in the appropriate subsection of Section 6, Option and Accessory Information.



A = Scanner PCB's (-04, -05, -06, -33) and their input connectors (-03, -07, -08, -28, -29, -30).

B = I/O Interface PCB's (-12, -13, -14 Series and -16, -23).

C = Alarm Setpoint Option (-34)

Figure 2-4. 2200B Option Installation Locations

2-22. Scanner Extension

2-23. The channel scanner capacity of the 2200B can be extended from 60 channels up to 100 channels. The extension is accomplished through the use of the Model 2201A, 2202A, 2203A scanner chassis, which are available as accessories. The units connect to the 2200B at a rear panel connector on the A/D Converter PCB.

2-24. Each scanner chassis is capable of housing and controlling eight (2203A) to ten (2201A or 2202A) scanner blocks. Since each block contains 10-channels, and the 2200B is capable of housing six blocks (60 channels), a full complement of 100 channels can be achieved by adding four 10-channel scanner blocks to the scanner chassis. The 2201A, 2202A and 2203A scanner chassis are documented in separate stand-alone instruction manuals.

2-25. Internal Switch Settings

WARNING

THE INTERNAL SWITCHES ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT ATTEMPT TO SET THESE SWITCHES UNLESS YOU ARE QUALIFIED TO DO SO. SEE SECTION 4 OF THIS MANUAL.

2-26. Several control and function enable switches are contained on the interior of the 2200B. These switches are not intended for use by the operator, and are mentioned at this time for identification purposes only. Each of the switches is named and its location defined in Table 2-2. Instructions for properly setting each switch are contained in Section 4 of this manual.

Table 2-2. Internal Switch Information

SWITCH NAME	LOCATION
50/60 Hz	Power Supply PCB
115/230V ac	Power Supply PCB
°C/°F	Controller PCB, switch 3
Block/Individual	Controller PCB, switch 4
External All/Alarm	Controller PCB, switch 1
Alarms Once/All	Controller PCB, switch 2
Fast/Slow	A/D Converter PCB

2-27. Individual/Block Mode

2-28. Either of two programming modes can be selected for assigning function and limits data to the 2200B channels: the individual mode, or the block mode. In both modes 10 different programs are involved. The individual mode allows nine of the programs to be assigned to channels 00 through 08. The tenth program is assigned to channels 09 through 99. When block mode is selected, each of the 10 programs is assigned to a separate block of 10 channels. That is, channels 0 through 9 (block 0) share a single program, channels 10 through 19 (block 1) share another, and so on through block 9 (channels 90 through 99).

2-29. The individual or block mode of operation is selected by a switch (4) located on the Controller PCB Assembly on the interior of the 2200B (see Figure 2-4). The individual mode is selected when the switch is set to ON; OFF selects the block mode. See Section 4 for the selection procedure.

2-30. Temperature Scale, °C/°F

2-31. The temperature measurement scales assigned to T1, T2, T3 and/or T4 can be set (using a switch on the Controller PCB Assembly) to provide a direct temperature readout in either °C or °F. Information necessary to properly set the switch is given in Section 4 of this manual.

NOTE

Thermocouple temperature measurements require the use of an Isothermal Block Connector (Option -08).

NOTE

When a series of C's is displayed during a scan sequence, it indicates that the thermocouple input for the channel indicated is open circuited (R source $>7.5 \pm 2.5$ kΩ).

2-32. Measurement Speed, Fast/Slow

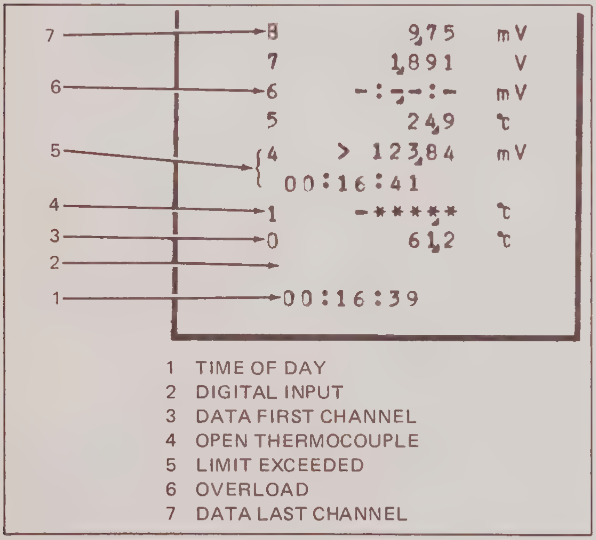
2-33. The measurement speed of the High Performance A/D Converter can be set for either 3 (slow) or 15 (fast) readings per second. The selection of measurement speed is accomplished by setting a slide switch on the A/D Converter PCB to the fast or slow position. The access procedure, the switch location, and the switch settings are described later in Section 4 of this manual.

2-34. Print/Record Format

2-35. Measurement data generated during a scan sequence can be recorded on the printer and/or any external recorders interfaced with the 2200B. Switches in the OUTPUT CONTROL group allow the operator to independently select the desired recording device(s) (printer and/or external recorder). In addition, the operator can select the data format to be recorded on the printer, all data or alarm data. An example of an all data print out is shown in Figure 2-5.

2-36. If the alarm data format is used, either of two modes can be selected, alarm once or all alarm. The alarm once mode causes alarm data to be printed only when it is first detected. If the data still exceeds its limits on subsequent scans, it is not recorded. When data returns within limits it is recorded again. In the all alarm mode, alarm data is printed whenever it is measured. The selection of the alarm once or all alarm mode is accomplished by setting a switch (#2) on the Controller PCB Assembly. The access procedure, the switch location and the switch settings are described in Section 4 of this manual.

2-37. The format of data recorded on external devices (interfaced with the 2200B through the -12, -13 or -14 Options) can be selected to occur as either all data or alarm data only. The recorder is enabled when the EXTERNAL ON switch in the OUTPUT CONTROL group is depressed. Format (all data or alarm data) is selected by setting a switch (#1) on the Controller PCB Assembly. Refer to Section 4 of this manual for the switch setting procedure.



```
8          9,75   mV
7         1,891    V
6        -:-:-    mV
5          24,9    ℃
{4     > 123,84   mV
{ 00:16:41
1        -*****    ℃
0          61,2    ℃

00:16:39
```

1 TIME OF DAY
2 DIGITAL INPUT
3 DATA FIRST CHANNEL
4 OPEN THERMOCOUPLE
5 LIMIT EXCEEDED
6 OVERLOAD
7 DATA LAST CHANNEL

Figure 2-5. Typical Format of Printed Data

2-38. Program Memory

2-39. The 2200B is equipped with a non-volatile memory which is impervious to power interruptions caused by either power failures or switching the instrument to power off. during power-down conditions, the memory is maintained by a lithium battery. Battery life expectancy is at least 5 years.

2-40. Programmable Limits

2-41. The 2200B can be equipped with an Alarm Set Point (Option -34) that allows up to 40 unique limit values to be established for use in programming the channels/blocks. The limit values are programmable and may be assigned to either 10 individual channels or 10 blocks (10 channels per block) depending upon the selected 2200B programming mode, individual or block. In the individual mode four limit values may be programmed for each of channels 0 through 9. Channels 10 through 99 assume the limit values that are assigned to channel 9. In the block programming mode, four limit values may be programmed for each of the 10 possible blocks, 0 through 9.

2-42. Limit values are programmed during a channel/block programming sequence, and consist of sense (>, <, skip), polarity (+, -), and a four-digit numeric value. The actual numeric value can range from a minimum of -39990 to a maximum of +39990. The least significant digit (fifth digit) cannot be programmed and is always 0 (zero). Since the programmed values are to be compared directly against the measurement reading, care must be taken to ensure that the limit values are compatible with the selected function and range, and vice-versa. For example, a limit value of +1000 can represent a limit of 10.000V, 1.0000V, 100.00 mV, 10.000 mV, 1000.0°F or 1000.0°C depending upon the selected function. Notice that the decimal point in the limit value is assumed to be in the same position as that of the selected function.

2-43. When a limit is exceeded during a scan sequence there are no front panel indicators to notify the operator unless the internal printer is enabled. Out-of-limits (alarm) data is then printed in red and identified as greater than (>) or less than (<) the specified limit. The date and time is also printed prior to each out-of-limits measurements. If an external recording device is enabled, it too will be provided with the alarm indication.

2-44. Even though four limit values are available for each channel/block, only two are required to define the high/low limits for a given measurement. The remaining two limit values are normally programmed to skip. However, if the 2200B is equipped with the Alarm Set Point Output (Option -23), two pairs of limits can be assigned to a single measurement. The Alarm Set Point Output is capable of distinguishing between the limit pairs and issuing an alarm for one or both pairs. This ability to separate the limit pairs allows the limits to be used to classify or grade the measurements, i.e., good, better, best.

2-45. Scan Control

2-46. The scan sequence is both started and stopped by six of the switches which comprise the SCAN CONTROL group. Five switches (SINGLE, INTERVAL, MONITOR, CONTINUOUS, REMOTE) are provided to initiate separate variations of the scan sequence and a single STOP/RESET/PROGRAM switch is provided to terminate the selected sequence. The basic sequence is initiated by the SINGLE mode switch, and is keyed to the manually entered program data. A simplified sequence of events in the single scan mode is as follows:

1. The first channel (as selected on the thumbwheel switches) relay closes and connects an external stimulus to the input of the A/D Converter.

2. The A/D converter measures the input signal in terms of the programmed function (volts, millivolts or temperature) and provides a digital display of the results.

3. The displayed value is compared with the programmed limits value (if the Alarm Set Point, Option -34, is installed).

4. The channel, measurement and function data are recorded if a recording device has been enabled via the OUTPUT CONTROL switch group.

5. The first channel relay is opened and the second channel relay in the sequence is closed to connect its external input to the A/D Converter.

6. Steps 2, 3, and 4 are repeated.

7. The channel relay is opened and the next channel in the programmed sequence is closed. The input is measured and recorded.

8. Step 7 is repeated for each programmed channel until the last channel (as selected on the thumbwheel switches) has been scanned. At that time the single or basic scan sequence has been completed.

2-47. Variations of the single scan mode are intitated when INTERVAL, CONTINUOUS or MONITOR switches are pressed. The interval scan mode causes the single scan sequence to be repeated at a programmed time interval. The time interval is measured from the start of one sequence to the start of the next sequence. The time can be programmed in 1 minute increments from 1 minute to 23 hours 59 minutes. The continuous mode causes the scan sequence to be continuously repeated with a minimum time between the end of one sequence and the start of the next (typically ⩽1 second). The monitor scan mode allows the operator to continuously monitor a single selected channel. The monitored channel is selected by the MONITOR CHANNEL thumbwheel switches. All channels can be manually scanned in the monitor mode by incrementally advancing the MONITOR channel switches.

2-48. The remote mode is operational only when one or more of the output options pcbs (-12, -13, -14 series) are installed in the 2200B. Depressing the REMOTE switch enables a single scan to be initiated upon receipt of a remote trigger via one of the output options. Refer to the appropriate output option in Section 6 for details concerning the remote control input requirements.

2-49. Improper Program Data

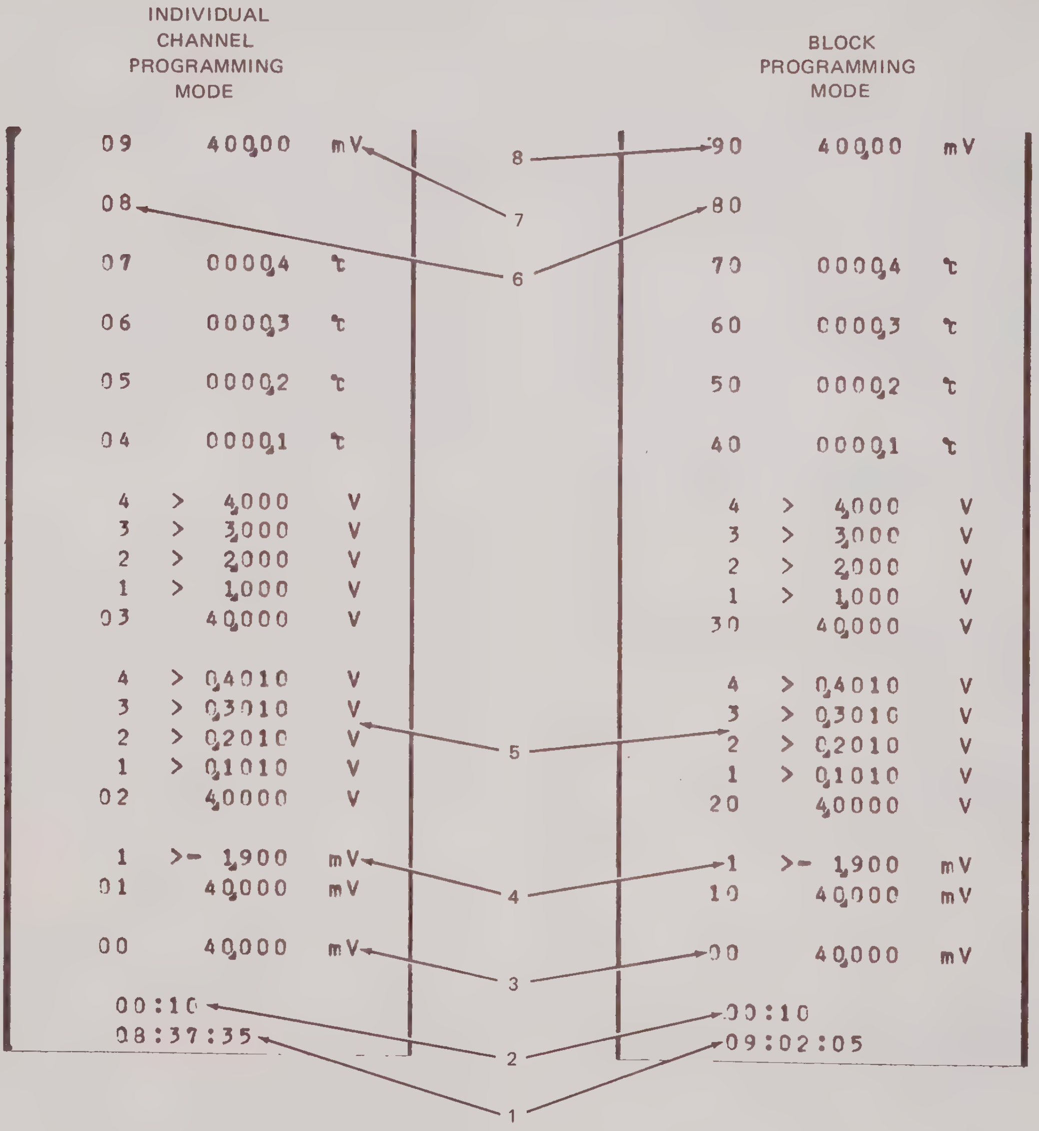
2-50. The 2200B will not accept illegal or improperly formatted program data. When an operator error in format or data entry occurs, the front panel display reads [[[]]]. This reading indicates that the data was invalid and not entered into program memory. The condition is cleared by restarting the program sequence and entering valid program data or selecting a scan control function.

2-51. Program List

2-52. The 2200B is equipped with a program list feature which allows the operator to solicit and record the contents of program memory. The listed information includes time-of-day, time interval and channel programming for 10 individual channels or blocks depending upon the mode selected. Channel/Block programming consists of the input function and, when Option -34 is installed, up to four limit values. Examples of program lists for both the individual and block modes are given in Figure 2-6. The program list feature should be employed both before and after entering new program data. By listing the old program, the operator will know what must be added to or deleted from memory during the reprogramming process. Listing a newly entered program allows the operator to verify program accuracy.

NOTE

The program list feature requires that both the ALL DATA switch in the OUTPUT CONTROL group and the RESET switch in the SCAN CONTROL switch group be depressed prior to pressing the PROGRAM LIST switch.



```
09      400.00   mV
08
07      0000.4   ℃
06      0000.3   ℃
05      0000.2   ℃
04      0000.1   ℃
 4   >   4.000    V
 3   >   3.000    V
 2   >   2.000    V
 1   >   1.000    V
03      40.000    V
 4   >  0.4010    V
 3   >  0.3010    V
 2   >  0.2010    V
 1   >  0.1010    V
02      4.0000    V
 1   >- 1.900    mV
01      40.000   mV
00      40.000   mV
  00:10
 08:37:35
```

```
90      400.00   mV
80
70      0000.4   ℃
60      0000.3   ℃
50      0000.2   ℃
40      0000.1   ℃
 4   >   4.000    V
 3   >   3.000    V
 2   >   2.000    V
 1   >   1.000    V
30      40.000    V
 4   >  0.4010    V
 3   >  0.3010    V
 2   >  0.2010    V
 1   >  0.1010    V
20      4.0000    V
 1   >- 1.900    mV
10      40.000   mV
00      40.000   mV
 00:10
09:02:05
```

1 TIME OF DAY
2 INTERVAL
3 CHANNEL/BLOCK 0 FUNCTION, LIMITS SKIPPED
4 LIMIT 1 FOR CHANNEL/BLOCK 1
5 FOUR LIMIT VALUES ON CHANNEL/BLOCK 2
6 CHANNEL/BLOCK 8 FUNCTION SKIPPED
7 FUNCTION AND LIMITS FOR CHANNELS 9 THROUGH 99
8 FUNCTION AND LIMITS FOR BLOCK 9 (CHANNELS 90 THROUGH 99)

Figure 2-6. Program List Examples

2-53. System Self-Check

2-54. Two output voltages (+0.02 and +2.0V dc) are available at the rear of the data logger on the High Performance A/D Converter PCB. These voltages can be temporarily attached to a suspect channel to check its operation, or permanently connected to dedicated channels to establish a system self-check feature. The location of the test voltage output connectors (TP1, TP2 and TP3) is shown in Figure 2-1.

2-55. OPERATION

2-56. Turn-On Procedure

2-57. The following procedure is recommended for initial turn-on of the 2200B:

1. Install available options as required.

2. Connect interface cables as required.

3. Connect the 2200B to line power.

4. Press the RESET/PROGRAM switch in the SCAN CONTROL group.

5. Set the POWER switch to the depressed position (on). The display should illuminate and read 2200-1 until a scan is started or block/channel programming is performed.

2-58. Turn-Off Procedure

2-59. The turn-off procedure consists of a single step; press and release the POWER switch.

NOTE

The turn-off procedure will not clear or alter the data present in the program memory.

2-60. Entering Program Data

2-61. Meaningful operation of the 2200B requires the manual entry of a series of program words to define the variables associated with a scan sequence. The procedures required to enter each variable are given in the following paragraphs. Completion of the entire series of procedures, in the order given, is recommended to familiarize the inexperienced operator with the programming requirements of the 2200B. However, it is not necessary for the experienced operator to complete the procedures in the order given. Nor, is it necessary to complete an entire procedure. Thus, variables not affected can be omitted from any of the procedures.

NOTE

Generating a written program prior to entry simplifies the programming process, and ensures duplication when re-entering old programs. A recommended format for a program form is given in Figure 2-7.

NOTE

Complete the Turn-on procedure before attempting to program the 2200B.

2-62. TIME-OF-DAY CLOCK

2-63. The time-of-day clock must be updated after the turn-on procedure is performed and after recovery from a power interruption. Use the following procedure to update the time-of-day clock:

1. Set the thumbwheel switches flagged by the ENTER TIME switch to:

   0hhmm
   Where:
   0 = Clock or time-of-day data.
   hh = Hours from 00 to 23.
   mm = Minutes from 00 to 59.

2. Synchronize the clock to an external standard by pressing the ENTER TIME switch at the switch-time setting. The clock will be updated and begin running when the switch is pressed (seconds count will start at 00).

2-64. TIME INTERVAL

2-65. Program time interval as follows:

1. Set the thumbwheel switches flagged by the ENTER TIME switch to:

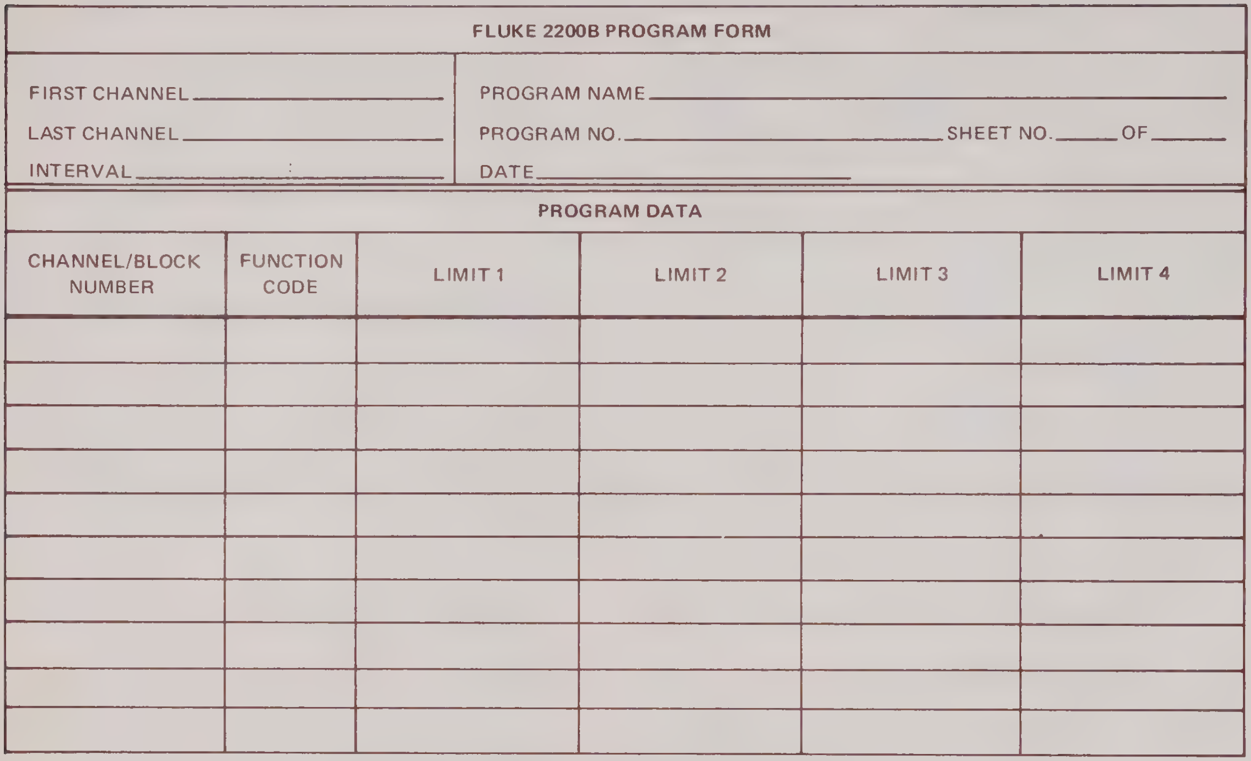
   1hhmm
   Where:
   1 = Time interval data.
   hh = Hours from 00 to 23.
   mm = Minutes from 00 to 59.

2. Press the ENTER TIME switch.

2-66. CHANNEL/BLOCK DATA

2-67. Use the following procedure to assign function and/or limits data to the 10 individual channel/block programs:

1. Set the thumbwheel switch flagged by the SELECT CHANNEL switch to 0.



FLUKE 2200B PROGRAM FORM

FIRST CHANNEL ____________
LAST CHANNEL ____________
INTERVAL ____________

PROGRAM NAME ____________
PROGRAM NO. ____________ SHEET NO. ______ OF ______
DATE ____________

PROGRAM DATA

CHANNEL/BLOCK NUMBER	FUNCTION CODE	LIMIT 1	LIMIT 2	LIMIT 3	LIMIT 4

Figure 2-7. 2200B Program Form, Recommended Format

2. Press the SELECT CHANNEL switch. The channel display should read 00: this corresponds to channel 0 or block 0 depending upon the mode selected, individual or block.

3. Set the thumbwheel switch flagged by the ENTER FUNCTION switch to the number (0-8) that corresponds to the desired function. A number-to-function cross reference is provided on the front panel decal.

4. Press the ENTER FUNCTION switch to assign the selected function to the displayed channel/block. If skip is selected, proceed to step 8 of this procedure.

5. Set the thumbwheel switches flagged by the ENTER LIMITS switch to the desired limits value or skip(s) and assign a limit number of 1.

6. Press the ENTER LIMITS switch to assign the limit value to the displayed channel/block.

7. Assign limit values to the remaining limit numbers, i.e., 2, 3 and 4. If a limit value is not required set the sense switch to S (skip) and press ENTER LIMITS.

8. Program the remaining channel/blocks using the techniques described in steps 1 through 7 of this procedure.

2-68. FIRST/LAST CHANNEL

2-69. After function and limits data has been entered, and before a scan sequence (other than monitor) is initiated, first and last channel assignments must be made. This is accomplished by setting the thumbwheel switches flagged FIRST CHANNEL and LAST CHANNEL to appropriate channel numbers. These settings are not transferred into memory and, therefore, must remain fixed. In other words, a change in these switch positions will cause a corresponding change in first/last channel assignments.

2-70. MONITOR CHANNEL

2-71. When the monitor scan control mode is to be used, set the desired channel number on the thumbwheel switches flagged by the MONITOR switch. Pressing the MONITOR switch will then cause that channel to be measured. Function and limit data for the monitor channel is the same as that previously entered into memory as channel/block data. The monitor channel is measured on every scan cycle.

Section 3

Theory of Operation

3-1. INTRODUCTION

3-2. This section of the manual contains an overall functional description followed by a Block Diagram Analysis of the Model 2200B Data Logger. Both descriptions are supported by simplified block diagrams. Detailed schematics of the individual pcb assemblies are given in Section 8 of this manual.

3-3. OVERALL FUNCTION DESCRIPTION

3-4. The 2200B, as shown in Figure 3-1, is a data processor and recorder which is expandable, through the use of option plug-in modules, into a user designed data acquisition system capable of servicing up to 100 channels of guarded analog data. Logically, the 2200B can be divided into two major sections, analog and digital. The analog section comprises the Scanner PCB's and the A/D Converter. The remaining blocks comprise the digital section.

3-5. The analog section of the 2200B is an electrically isolated scanner and a/d converter which is used to interface the individual channels of analog data with the control logic contained in the digital section. Analog data is presented to the analog section through a series of plug-in relay scanner pcb's (up to 10 ten-channel scanner pcb's can be serviced). The individual channels are energized under digital control, and the selected channel data is measured and digitized by a dual-slope a/d converter (the analog portion of which is contained in the A/D Converter PCB while the digital portion is contained on the Guard Crossing PCB). After each channel measurement is completed, the Guard Crossing PCB transfers the digitized measurement data across an optically isolated buffer to the digital section. All additional processing of measurement data (e.g., display, recording and comparison) is accomplished by the digital section.

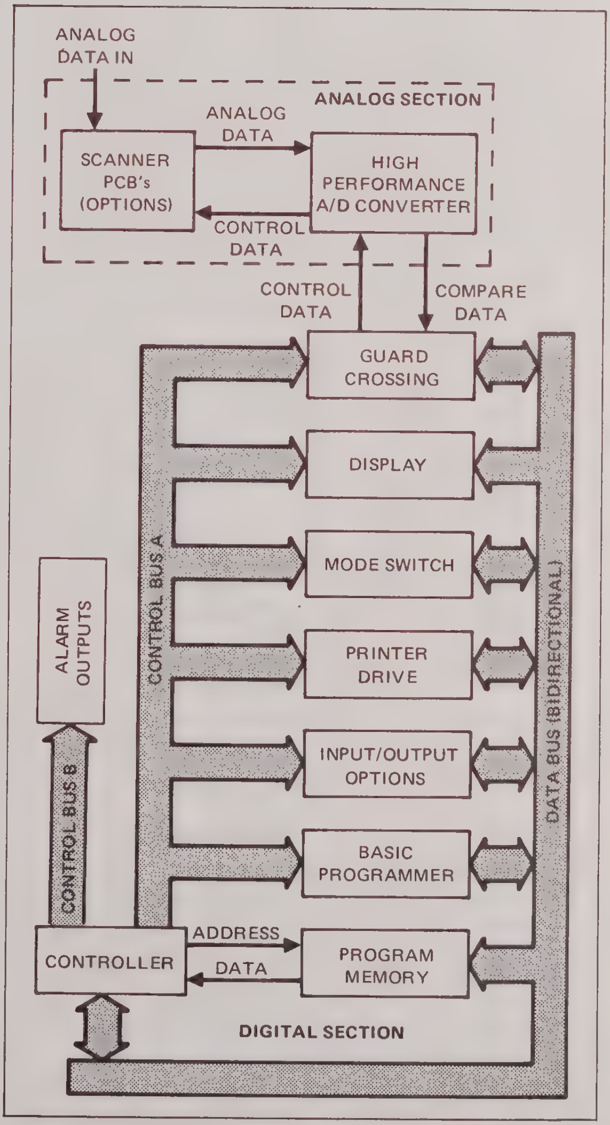

ANALOG DATA IN
ANALOG SECTION
ANALOG DATA
SCANNER PCB's (OPTIONS)
HIGH PERFORMANCE A/D CONVERTER
CONTROL DATA
CONTROL DATA
COMPARE DATA
GUARD CROSSING
DISPLAY
MODE SWITCH
PRINTER DRIVE
INPUT/OUTPUT OPTIONS
BASIC PROGRAMMER
PROGRAM MEMORY
CONTROL BUS A
DATA BUS (BIDIRECTIONAL)
ALARM OUTPUTS
CONTROL BUS B
CONTROLLER
ADDRESS
DATA
DIGITAL SECTION

Figure 3-1. Data Logger, Simplified Block Diagram

3-6. The digital section of the 2200B is a bus oriented system based upon a four-bit-parallel microprocessor (which is an integral part of the Controller). Three buses are used to route data within the digital section. Two are unidirectional control buses, and the third is a bidirectional data bus (which is used to exchange data between the microprocessor and the other elements of the digital section.

3-7. The control buses (four lines each) are identified as Control Bus A and Control Bus B, and are mutually exclusive in operation. Both control buses are used by the Controller to transmit address data to the various elements (peripherals) of the digital section. When a particular peripheral is addressed, communications between it and the Controller are possible via the bidirectional Data Bus. The address codes and assignments for both Control Bus A and Control Bus B are given in Table 3-1.

3-8. Each address code, in addition to addressing a particular peripheral, also defines the communication function the peripheral is to perform (i.e., transmit or receive). Therefore, peripherals which are capable of both transmitting and receiving data are assigned multiple address codes. Other peripherals, such as the Display, are only capable of receiving data, and therefore, require only one address code. Similarly, the Mode switches are assigned a single address code because they are only capable of transmitting data.

3-9. When an address code is placed on either of the control buses (A or B), the corresponding peripheral is enabled to perform the solicited function; transmit or receive. If a transmit function is enabled, (e.g., the Mode switches are addressed to transmit data on the Data Bus when a binary coded 8 (1000) is placed on Control Bus A), the responding peripheral immediately places its first 4-bit character onto the Data Bus. When the Controller reads the Data Bus it generates an In strobe. This strobe is used by the addressed peripheral to move the next character for transmission onto the Data Bus. The process is repeated until all of the characters (determined by the Controller) have been transmitted. At that time, the Controller removes the address code from the Control Bus and replaces it with a Null-Character Code, 0000. If the receive function is enabled, the process is similar. However, data moves from the Controller to the addressed peripheral, and an Out strobe is generated to allow the peripheral to receive each data character.

3-10. Three of the peripherals perform functions which are not normally synchronized by the Controller. They are the Power Supply, the Printer and the Guard Crossing. The Power Supply generates a 1 Hz clock pulse to maintain the interval counter, the Printer records data supplied via the data bus and the Guard Crossing sends a/d measurement data to the Controller via the Data Bus. Since the operation of these peripherals is not synchronized with the Controller, each is provided with an interrupt line (IRQ) to notify the Controller that they are ready to perform their function. When any one of the units pull the IRQ line, the Controller responds by interrupting its normal data processing routine and sequentially requesting the status of each of the three peripherals; Guard Crossing, Printer and Power Supply, respectively. The interrupting unit is identified by its status code and serviced as necessary. When multiple interrupts occur, priority is established by the status interrogation sequence. (The interrupt circuit for the Power Supply's 1 Hz output is actually contained on the Controller PCB.)

Table 3-1. Control Bus Address Codes

CONTROL BUS A		CONTROL BUS B	
CODE* 3 2 1 0	ASSIGNMENT	CODE* 3 2 1 0	ASSIGNMENT
0 0 0 0	Null Character	0 0 0 0	Null Character
0 0 0 1	Guard Crossing Transmit	0 0 0 1	Not Used
0 0 1 0	Guard Crossing Receive	0 0 1 0	Not Used
0 0 1 1	Guard Crossing Status	0 0 1 1	Not Used
0 1 0 0	Output Receive	0 1 0 0	Not Used
0 1 0 1	Printer Receive	0 1 0 1	Not Used
0 1 1 0	Remote/Output Status	0 1 1 0	Not Used
0 1 1 1	Input Transmit	0 1 1 1	Not Used
1 0 0 0	Mode Switch Transmit	1 0 0 0	Not Used
1 0 0 1	Display Receive	1 0 0 1	Not Used
1 0 1 0	Basic Programmer Transmit	1 0 1 0	Not Used
1 0 1 1	Not Used	1 0 1 1	Not Used
1 1 0 0	Configuration Transmit	1 1 0 0	Alarm Output Receive
1 1 0 1	Printer/Interval Status	1 1 0 1	Not Used
1 1 1 0	Not Used	1 1 1 0	Not Used
1 1 1 1	Not Used	1 1 1 1	Not Used

**Each control bus contains 4 lines. Control Bus A = CA0 through CA3. Control Bus B = CB0 through CB3.*

3-11. BLOCK DIAGRAM DESCRIPTION

3-12. Introduction

3-13. A block diagram description of the 2200B is given in the following paragraphs. The description is keyed to the detailed block diagram shown in Figure 3-2. Each block or group of blocks represents a pcb assembly which is supported by a detailed schematic in Section 8 of this manual. Options are described in Section 6.

3-14. Controller PCB Assembly

3-15. The Controller PCB Assembly contains the microprocessor set and its associated program memory and control circuitry. The microprocessor set consists of CPU (U9), Memory Interface (U10) and four RAM's (U19, U20, U21). ROM's (U3, U4, U5, U11 and U12) comprise the program memory. Supporting control circuits include a 2 phase Clock Generator, the Interrupt Circuit and the Configuration switches.

3-16. MICROPROCESSOR SET

3-17. The microprocessor set solicits and responds to program data stored in four separate locations; the Control Program ROM, the Configuration PROM, the Temperature ROM and the Program Memory. The Control Program ROM contain the program data that determines the basic characteristics of the 2200B. The Configuration PROM and the Temperature ROM contain alternate temperature measurement programs that can be enabled under program control. The Program Memory is manually programmed via the 2200B front panel and provides the microprocessor set with the measurement functions assigned to the various channels and limit values.

3-18. To access data in one of the four program data locations, the CPU (U9) generates a 12-bit address in the form of three serial, 4-bit characters. These characters are presented to the Memory Interface (U10) where they are assembled into a 12-bit parallel address word and placed on the ROM Address Bus. The address word is then presented in parallel to each of the four program data locations. To ensure a response from only the desired program data location, an additional location-enable line is required. Control data for this line is derived from the CPU address word. RAM U19 and 1-of-10 decoder U15 generates the enable for the Configuration and the Control Program ROM. The Temperature ROM and the Program Memory are enabled simultaneously via the Memory Interface Program Memory (PM) output. The three enable lines are mutually exclusive in operation.

3-19. Program data from the addressed program-data location is placed on the 8-bit ROM data Output Bus (01 through 08) and read by the Memory Interface. The data is then either returned to the CPU for further processing or placed on the Data Bus for use by the peripheral I/O pcb assemblies.

3-20. Since the Control Program ROM (U3 or U4) contain the instructions which determine the characteristics of the 2200B they must be addressed when the unit is initially energized. This is accomplished by forcing U19 to present a binary coded 7 (0111) to the 1-of-10 decoder U15, thereby, enabling the Control Program ROM's to respond to the initial 12-bit address on the ROM Address bus. Subsequent program data locations are accessed under the direction of the Control Program.

3-21. Control and Response Data to and from the Controller PCB Assembly is routed over the bidirectional Data Bus under the direction of the Control Program ROM's. The appropriate peripheral and its desired response (transmit or receive) are solicited by address codes placed on Control Bus A. These codes are derived from the control program via RAM's U20 and U21. If the addressed peripheral is to return (transmit) data to the Controller PCB Assembly, the Memory Interface U10 generates an In strobe to retrieve character-serial data via the Data Bus. if the peripheral is to receive data from the Controller PCB Assembly, the Memory Interface generates an Out strobe after it places each character on the Data Bus. This enables the addressed peripheral to synchronize the serial I/O data with the Controller PCB Assembly.

3-22. TWO PHASE CLOCK GENERATOR

3-23. The microprocessor set is synchronized to a 2 phase, crystal controlled clock. The clock circuitry consists of a synchronous counter U8, a 5.185 MHz crystal Y1, gates U7 and U11, and a level shifter U2.

3-24. In operation, crystal Y1 provides the time base (1/5.185 MHz) for a free running oscillator. Counter U8 divides the oscillator output by seven and presents its Q1 (2) and Q2 (4) output to gates U7B (phase 1) and U7C (phase 2) for decoding. The decoded outputs are then presented to U2 where the 2 phase TTL output signals are shifted to the +5 and -10 volt levels required by the microprocessor set. The timing of the 2 phase clock is shown in Figure 3-3.

3-25. CONFIGURATION SWITCHES

3-26. The positions of the four Configuration switches, SW1 through SW4, are read by the microprocessor set when the 2200B is powered up. The switches are used as selectable variables which operate in conjunction with the data stored in program memory. Switch S1 selects data to be recorded on the external recorder(s), all data or alarm data. Switch S2 selects the alarm data to be recorded by the printer, alarm once or all alarm data. Switch SW3 defines the temperature scale, °C or °F, and SW4 selects the individual or block mode of programming.

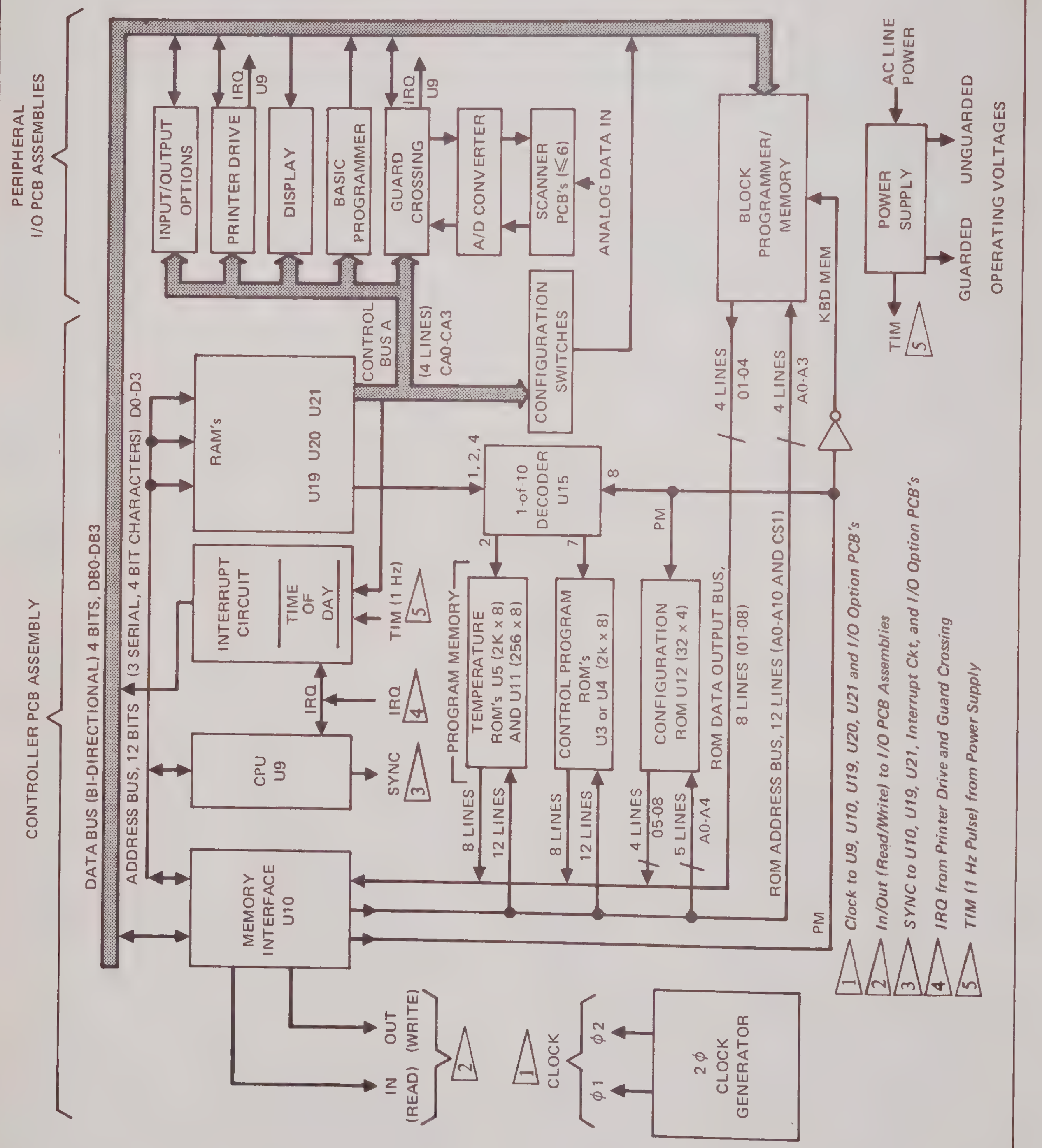

PERIPHERAL
I/O PCB ASSEMBLIES
CONTROLLER PCB ASSEMBLY
DATA BUS (BI-DIRECTIONAL) 4 BITS, DB0-DB3
ADDRESS BUS, 12 BITS (3 SERIAL, 4 BIT CHARACTERS) D0-D3
INPUT/OUTPUT OPTIONS
PRINTER DRIVE
IRQ
U9
DISPLAY
BASIC PROGRAMMER
GUARD CROSSING
IRQ
U9
A/D CONVERTER
SCANNER PCB's (≤6)
ANALOG DATA IN
BLOCK PROGRAMMER/ MEMORY
AC LINE POWER
POWER SUPPLY
UNGUARDED
GUARDED
OPERATING VOLTAGES
TIM
5
KBD MEM
CONTROL BUS A
(4 LINES) CA0-CA3
CONFIGURATION SWITCHES
RAM's
U19 U20 U21
4 LINES
01-04
4 LINES
A0-A3
1, 2, 4
1-of-10 DECODER U15
8
PM
2
7
INTERRUPT CIRCUIT
TIME OF DAY
TIM (1 Hz)
5
IRQ
IRQ
4
CPU U9
SYNC
3
PROGRAM MEMORY
TEMPERATURE ROM's U5 (2K x 8) AND U11 (256 x 8)
CONTROL PROGRAM ROM's U3 or U4 (2k x 8)
CONFIGURATION ROM U12 (32 x 4)
ROM DATA OUTPUT BUS, 8 LINES (01-08)
ROM ADDRESS BUS, 12 LINES (A0-A10 AND CS1)
8 LINES
12 LINES
8 LINES
12 LINES
4 LINES
05-08
5 LINES
A0-A4
PM
MEMORY INTERFACE U10
OUT (WRITE)
IN (READ)
2
CLOCK
1
φ2
φ1
2φ CLOCK GENERATOR
1 Clock to U9, U10, U19, U20, U21 and I/O Option PCB's
2 In/Out (Read/Write) to I/O PCB Assemblies
3 SYNC to U10, U19, U21, Interrupt Ckt, and I/O Option PCB's
4 IRQ from Printer Drive and Guard Crossing
5 TIM (1 Hz Pulse) from Power Supply

Figure 3-2. 2200B Data Logger Detailed Block Diagram

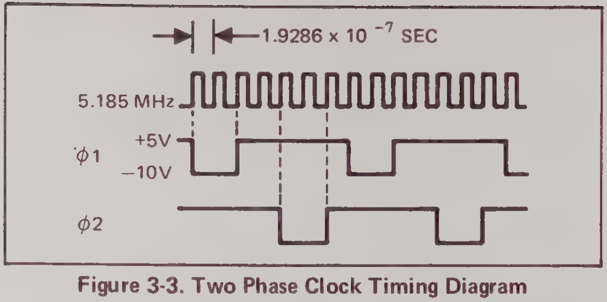


Figure 3-3. Two Phase Clock Timing Diagram

3-27. After the 2200B is energized, the microprocessor set places a binary coded 12 (1100) on Control Bus A. The address is detected by U29 which, in turn, enables the tri-state driver U27. All switch positions are placed on the Data Bus by U27, and read by the CPU when the Memory Interface generates an In strobe. Switch data is assigned to the Data Bus as follows: SW1 to DB3, SW2 to DB2, SW3 to DB1, SW4 to DB0. After the switch data is read, the binary-coded-12 address is removed from the Control Bus A and the tri-state driver U27 reverts to its normal high impedance output state.

3-28. INTERRUPT CIRCUIT

3-29. The Interrupt Circuit comprises flip-flops U18, gates U13, U24 and U29A, tri-state buffer U27 (E2 half), and transistor Q4. The circuit operates in conjunction with the 1 Hz time interval marker (TIM, from the Power Supply) to update the interval counter in the CPU. When a TIM pulse is generated (5V dc), the next CPU Sync pulse sets flip-flop U18A. Subsequently, the IRQ line is pulled low by transistor Q4. As the CPU interrogates the status of the interrupt peripherals (Guard Crossing, Printer and Power Supply), it places a binary coded 13 (1101) on Control Bus A. This address is detected by U29A which, in turn, enables U27. The output of U18A is routed through U27 and a binary coded 2 is placed on the Data Bus (DB1). An In strobe is generated by the microprocessor to read the Data Bus and, thereby, update the interval counter. As the Data Bus is read, the In strobe sets flip-flops U18 and the IRQ line is cleared. The next Sync pulse clocks flip-flop U18 to remove the data from the Data Bus. When the TIM probe returns low, the next Sync pulse clocks flip-flop U18 to the reset state so that the process can be repeated when the next TIM pulse occurs.

3-30. Basic Programmer PCB Assembly

3-31. The Basic Programmer PCB Assembly is a Controller peripheral designed to function as the operator interface for manually-entered, front-panel program data. Data is entered on a series of seven thumbwheel switches. Periodically, the Controller interrogates the switch settings and uses the information to establish the measurement conditions for any given scan or programming sequence.

3-32. The simplified block diagram shown in Figure 3-4 identifies the functional logic contained on the Basic Programmer PCB and defines the major flow of data to, from, and within the pcb. Operation begins when the Controller places a binary coded 10 (1010) onto Control Bus A (CA0-CA3). A decoder on the Basic Programmer PCB detects the Control Bus code, and generates an

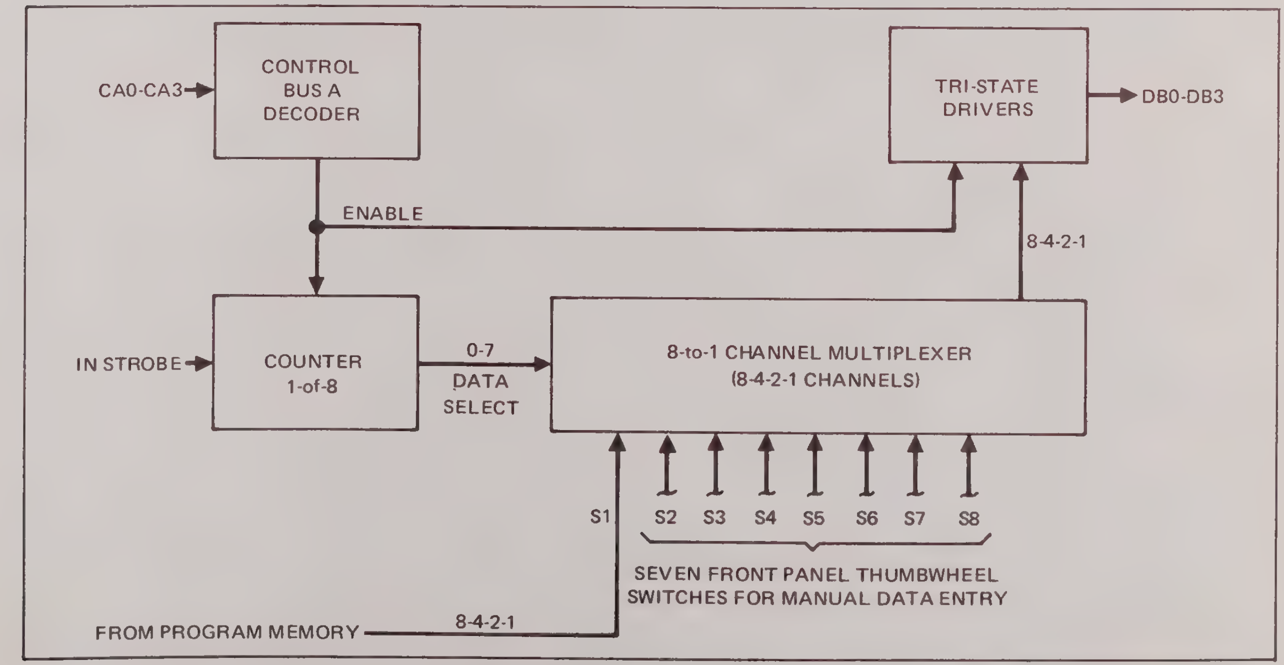


Figure 3-4. Basic Programmer, Simplified Block Diagram

enable output to both a counter and a series of four, tri-state drivers. Subsequent In strobe pulses from the Controller incrementally advance the counter and, thereby, scan each of the seven switches in the switch matrix. As each switch is scanned, its setting is fed to the four tri-state drivers which feed the Data Bus. As each In strobe occurs, the Controller reads the switch-setting information present on the Data Bus.

3-33. The counter is in the reset state (0) when the Basic Programmer PCB is enabled and is incremented through count 7 by a series of eight In stobe pulses from the Controller. Counter position 0 is used to read S1 on the Program Memory PCB. Count positions 1 through 7 are used to read the Basic Programmer's thumbwheel switches S2 through S8, respectively. After the eighth In strobe reads S8 the Controller removes the binary coded 12 from Control Bus A. This resets the counter to poistion 0 and disables the tri-state drivers to end the switch reading sequence.

3-34. Program Memory

3-35. The Program Memory PCB Assembly is a Controller peripheral designed to operate as a non-volatile memory for storing up to 10 different function codes for use in either the block or individual operating mode. The functional logic contained on the pcb, as well as the major flow of data to, from and within the pcb is shown in Figure 3-5.

3-36. Prior to initial data logger turn-on, previously entered function data is stored in a 256 X 4 RAM on the Program Memory PCB and is maintained by a 5.9V Lithium battery. The battery is switched into the circuit during the absence of the Power-On-Reset (POR) signal (high during power on) as derived from the Power Supply PCB. When power is turned on, the RAM's power-input terminal is switched from the battery supply to the unguarded +5V dc (line powered) power supply.

3-37. Program memory is enabled for either read or write applications when the RAM control logic detects the presence of both the power-on-reset signal from the power supply and the keyboard memory signal (Kbd Mem) from the Controller. Keyboard Memory also enables a series of four tri-state drivers which, normally, isolate the RAM output from the Output Bus. With these drivers enabled RAM data can be placed onto the Output Bus and read by the Controller.

3-38. When memory is enabled a particular location (address) within the RAM is selected by the Controller for a read/write operation. An eight-bit address code (A0 through A7) from the Controller specifies the selected location. Data present in that location is then placed onto the Output Bus (01 through 04) and, if desired, can be read by the Controller. (The Controller generates an In strobe to read the Output Bus.) If a character is to be written into the addressed location, the Controller places the new function character (as indicated by the FUNCTION switch setting) onto the Data Bus (DB0 through DB3) and, when the front panel ENTER switch is pressed, generates an Out strobe.

3-39. Both the read and write operations carried out on the Programming Memory PCB occur as a direct result of the Basic Programmer PCB being read by the Controller. When the Basic Programmer PCB is addressed to transmit front panel switch data, its 1-of-8 counter is in position 0. This code enables the multiplexer to read switch S1 located on the Program Memory PCB.

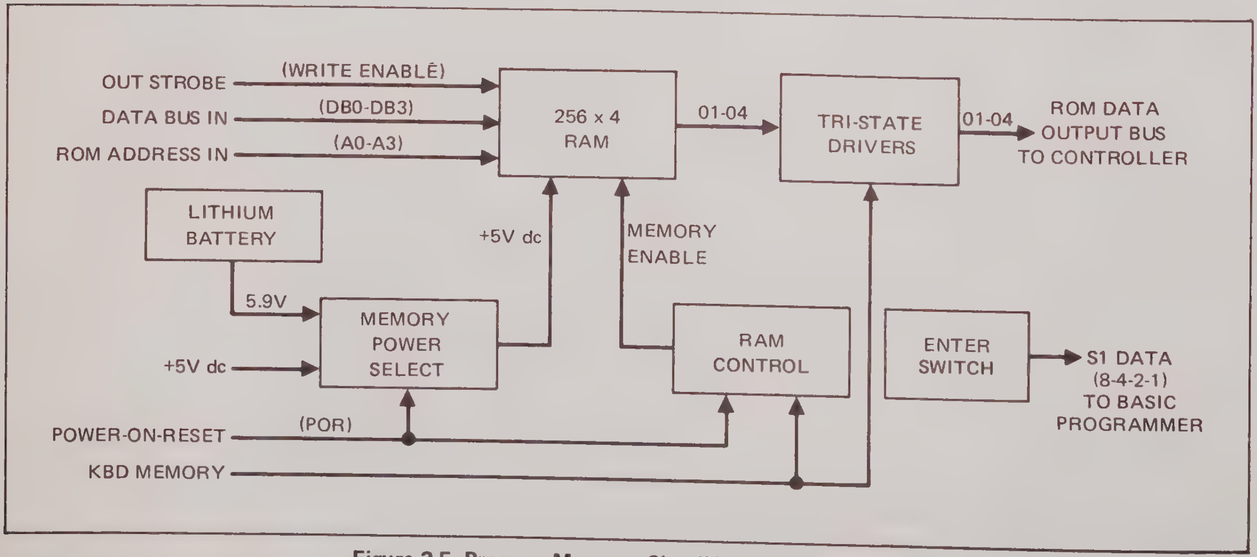


Figure 3-5. Program Memory, Simplified Block Diagram

3-40. Mode Switch PCB Assembly

3-41. The Mode Switch PCB Assembly, as shown in Figure 3-6, operates as a Controller peripheral and is capable of both transmitting and receiving data via the Data Bus. In the transmit mode, it provides the Controller with SCAN CONTROL and OUTPUT CONTROL switch-setting information. In the receive mode it accepts and stores numeric decade information from the Controller for use in driving the front panel display. The required operating mode is enabled via address data placed on Control Bus A and is executed under the direction of control signals received from the Controller.

3-42. In the transmit mode of operation the Mode Switch PCB Assembly scans the individual setting of the SCAN CONTROL and OUTPUT CONTROL switches and places the position information (depressed or out) onto the Data Bus for use by the Controller. Transmit mode operation begins when the Controller places a binary coded 8 on the Control Bus A. This code is detected by the Control Bus Decoder on the Mode Switch PCB and is used to enable a three-bit Multiplexer Address Control counter. The counter is sequenced by subsequent In strobe pulses from the Controller, and is used to sequentially address each channel of a three-channel (four-bit per channel) multiplexer. Each channel of multiplexed data contains the switch position information for up to four of the twelve CONTROL switch settings. This data is presented to the Data Bus on the leading edge of the In strobe, and is assimilated by the Controller on the trailing edge. At the end of the third In strobe all twelve CONTROL switch settings have been transmitted and the Controller removes the address code from Control Bus A. This isolates the Mode Switch PCB from the Data Bus and, thus, the Controller.

3-43. In the receive mode of operation the Mode Switch PCB receives updated display information from the Controller (via the Data Bus) and stores it in a 4 X 16 bit RAM. Receive mode operation begins when the

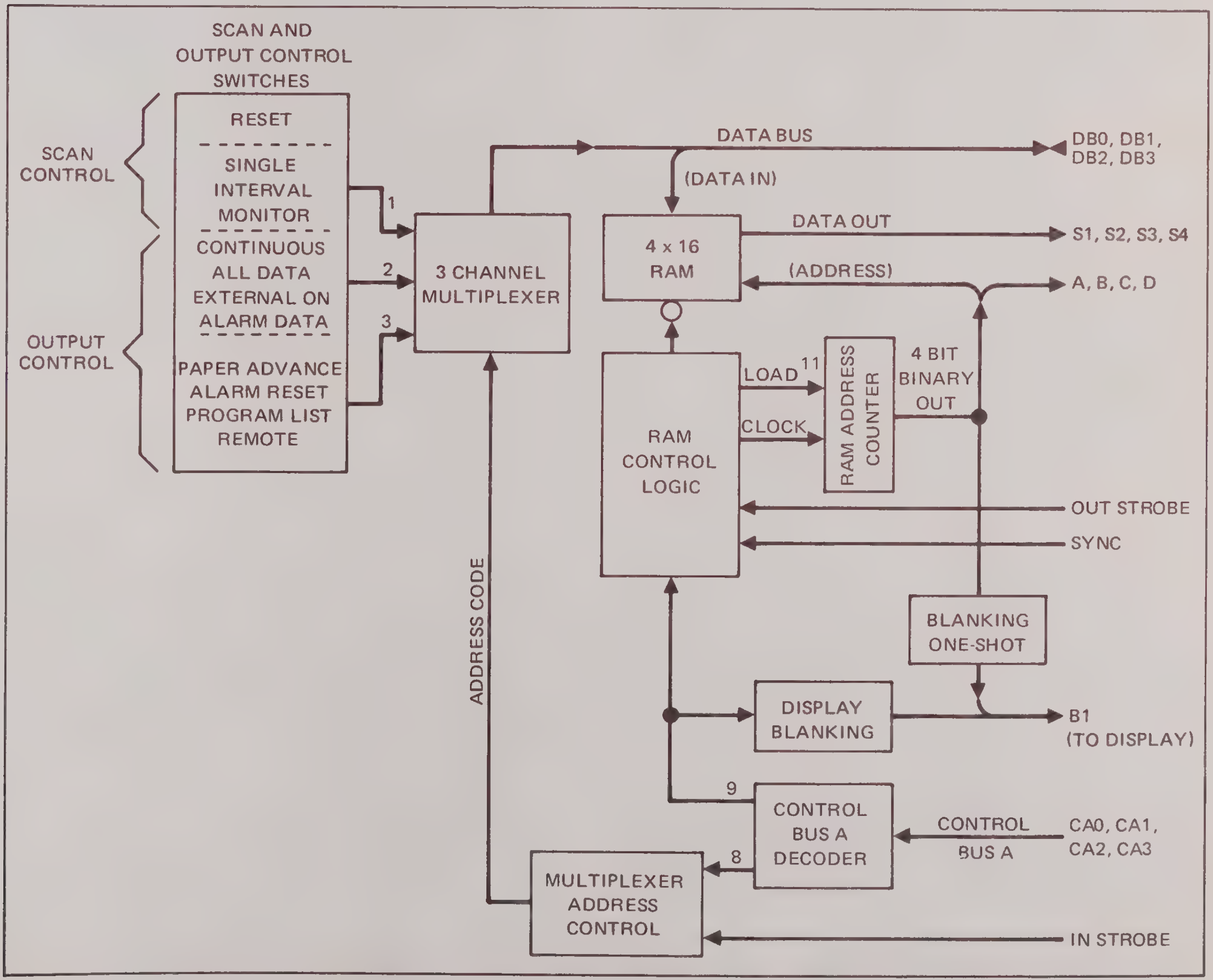

SCAN AND OUTPUT CONTROL SWITCHES
SCAN CONTROL
OUTPUT CONTROL
RESET
SINGLE INTERVAL MONITOR
CONTINUOUS
ALL DATA
EXTERNAL ON
ALARM DATA
PAPER ADVANCE
ALARM RESET
PROGRAM LIST
REMOTE
1
2
3
3 CHANNEL MULTIPLEXER
DATA BUS
DB0, DB1, DB2, DB3
(DATA IN)
DATA OUT
S1, S2, S3, S4
4 x 16 RAM
(ADDRESS)
A, B, C, D
LOAD
11
CLOCK
RAM ADDRESS COUNTER
4 BIT BINARY OUT
RAM CONTROL LOGIC
OUT STROBE
SYNC
ADDRESS CODE
BLANKING ONE-SHOT
DISPLAY BLANKING
B1 (TO DISPLAY)
9
CONTROL BUS A DECODER
CONTROL BUS A
CA0, CA1, CA2, CA3
8
MULTIPLEXER ADDRESS CONTROL
IN STROBE

Figure 3-6. Mode Switch, Simplified Block Diagram

Controller places a binary coded 9 code on Control Bus A. As a direct result of the address code, the RAM address counter is preset to binary coded 11 output (via the RAM control logic) and the front panel display is blanked by a high B1 level generated by the display blanking circuit. On the trailing edge of the next Sync pulse the RAM control logic is conditioned to respond to the Controller generated Out strobe. A valid display character precedes each Out strobe and is placed on the Data Bus by the Controller. On the leading edge of the first Out strobe the RAM'S write enable input is pulled low and the Data Bus character is entered into the binary coded 11 RAM location as defined by the RAM address counter. On the trailing edge of the Out strobe, the counter is decremented to 10 and new data is solicited from the Controller. The remaining 10 characters are similarly written into memory by the Controller. After all 11 characters of display data have been written, the Controller terminates the receive mode by removing the binary coded 9 code from Control Bus A.

3-44. When the Mode Switch PCB is not operating in the receive mode the Sync pulse causes the RAM control logic to continuously cycle and, thereby, address the RAM locations. As each location is addressed, its stored four-bit character is presented to the Display PCB via data output lines S1, S2, S3 and S4. Since the RAM does not output data via the Data Bus, transmit and RAM read operation are conducted simultaneously. However, receive and RAM read are mutually exclusive operations.

3-45. A blanking one-shot is used to blank the display if the counter stops running. This prevents the display segments (which are normally scanned) from drawing excessive current in a static situation.

3-46. Display PCB Assembly

3-47. The Display PCB Assembly, as shown in Figure 3-7, operates as an extension of the Mode Switch PCB Assembly. It provides a digital display of channel, measurement, and program data that has been processed by the Controller, and stored in the 4 X 16-bit RAM on the Mode Switch PCB Assembly. As the RAM locations are serially addressed and read, both the address and the stored data readings are presented to the Display PCB. Address data is received as inputs A, B, C and D. Stored data is received as inputs S1, S2, S3 and S4.

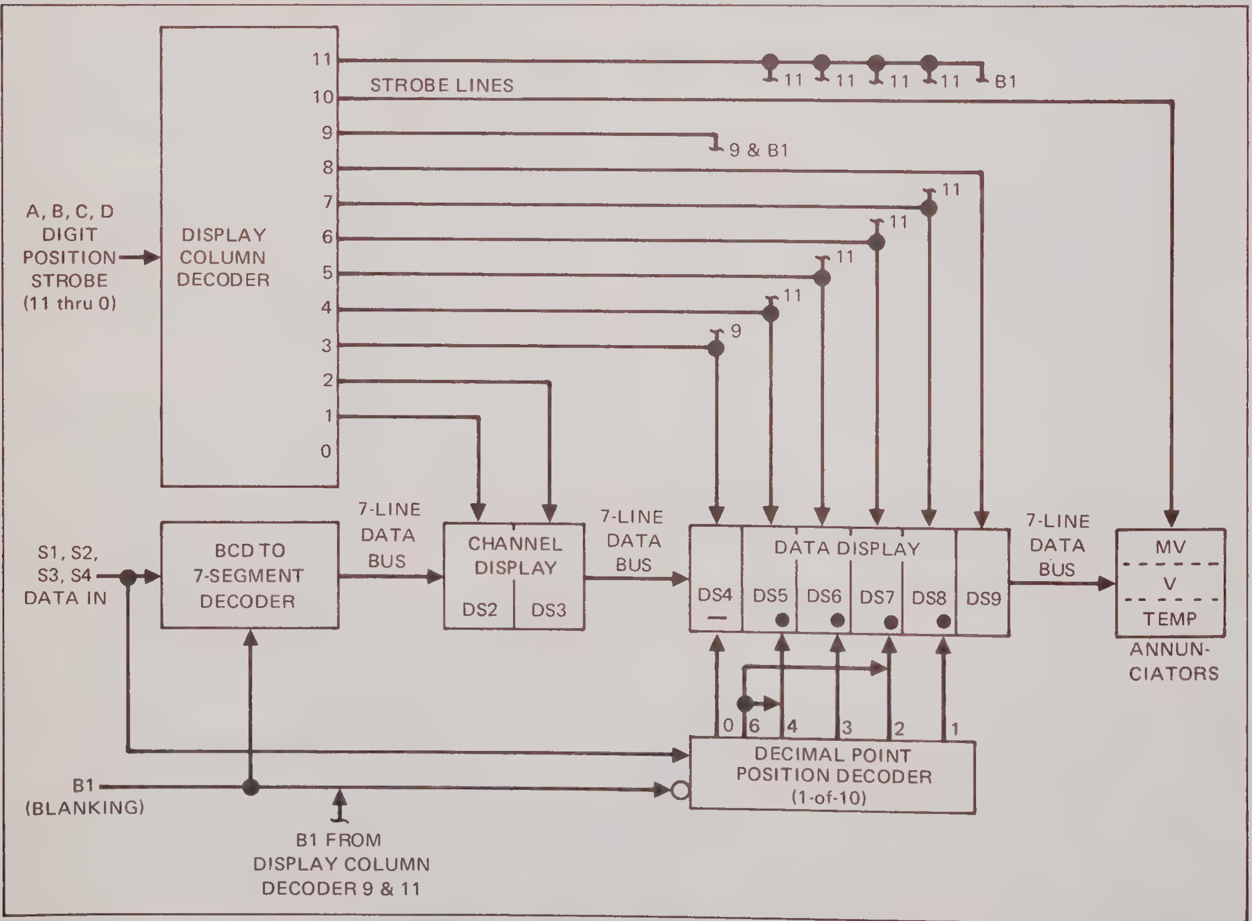

A, B, C, D
DIGIT
POSITION
STROBE
(11 thru 0)
DISPLAY
COLUMN
DECODER
11
10
9
8
7
6
5
4
3
2
1
0
STROBE LINES
11
11
11
11
B1
9 & B1
11
11
11
11
9
S1, S2,
S3, S4
DATA IN
BCD TO
7-SEGMENT
DECODER
7-LINE
DATA
BUS
CHANNEL
DISPLAY
DS2
DS3
7-LINE
DATA
BUS
DATA DISPLAY
DS4
DS5
DS6
DS7
DS8
DS9
7-LINE
DATA
BUS
MV
V
TEMP
ANNUN-
CIATORS
0
6
4
3
2
1
DECIMAL POINT
POSITION DECODER
(1-of-10)
B1
(BLANKING)
B1 FROM
DISPLAY COLUMN
DECODER 9 & 11

Figure 3-7. Display, Simplified Block Diagram

3-48. The individual display digits are formed by eight, 7-segment LED's. These LED's are driven in parallel by the output of a BCD-to-seven segment decoder whose input is taken directly from the Mode Switch as S1, S2, S3 and S4. Each of the LED's is individually strobed in serial fashion, and allowed to repsond to data present on the seven-line data bus. The strobe sequence is derived directly from the mode switch RAM address counter (A, B, C, D) and each strobed LED is allowed to read the addressed character stored in the (Mode Switch PCB's) corresponding RAM location. Since the data is scanned very rapidly (Sync pulse frequency 12), the display characters appear to be continuously lit.

3-49. In addition to the eight numeric characters, the Data Display PCB also contains provisions for driving the polarity (minus only), annunciator (MILLIVOLTS, VOLTS, TEMPERATURE), and decimal point LED's with data stored in the RAM on the Mode Switch PCB. Annunciator data is read from the seven-line data bus as if it were a numeric character. However, polarity and decimal point data are not. When either of these two RAM locations are addressed (binary coded 9 or 11) the resultant strobe (from display column decoder) disables the BCD-to-seven segment decoder and enables the decimal point position decoder. Under these conditions the seven-line data bus is disabled and data from the addressed RAM location is decoded by the decimal point position decoder. The appropriate decimal point location(s) and/or minus polarity LED's are driven by the output of the decimal point position decoder. Table 3-2 lists each of the display strobe lines decoded from the RAM address counter on the Mode Switch PCB, and indicates the data enabled during each display (strobe) period.

Table 3-2. Display LED Addresses and Functions

STROBE CODE	LED ENABLE	LED FUNCTION	
11	DS5, DS6, DS7, DS8	Decimal Points	
10	CR18, CR19, CR20	Annunciators	
9	DS4	Minus Sign	
8	DS9	LSD	Data Display
7	DS8	5th Digit	
6	DS7	4th Digit	
5	DS6	3rd Digit	
4	DS5	2nd Digit	
3	DS4	MSD	
2	DS3	LSD	Channel Display
1	DS2	MSD	
0	Not Used		

3-50. Printer Drive PCB Assembly

3-51. The Printer Drive PCB Assembly, as shown in Figure 3-8, operates as a Controller peripheral to interface the internal Seiko Model 102 print head with the Controller Data Bus. Both transmit and receive operating modes are employed in the printing operation. The transmit mode is used to solicit data from the Controller and to synchronize the Controller to the printer's mechanical rotation. In the receive mode the Controller sends printer data to the Printer Drive PCB Assembly via the Data Bus. Data for all 16 columns is printed within the time required for one rotation of the printer drum.

3-52. The Printer is a free-running device and (to print properly) requires that input data be synchronized with the mechanical rotation of its print drum. Print drum position information is generated by the print head in the form of a Reset pulse and a series of 13 TL-TP pulses. Reset is generated once for every print drum revolution and indicates that row 0 is positioned under the 16-column print hammers. TL-TP pulses are generated as each of the 13 possible data rows (0 through 12) are positioned beneath the print hammers. Therefore, for each print drum revolution 1 Reset pulse is generated and 13 TL-TP pulses are generated.

3-53. The TL-TP pulses from the printer are used by the Printer Drive PCB to synchronize the system clock (Sync) with the printer's drum position. Since the Sync pulse frequency is much higher than the TL-TP frequency, synchronization is accomplished by a coincidence detector and does not require a change in the drum rotation or system clock frequency. When either a Reset or a TL-TP pulse is detected, a pulse is generated by the synchronizing logic. This pulse arms the interrupt control logic to enable the next Sync pulse to generate an Interrupt to the Controller and, thereby, indicate that the printer's drum is in position to receive data.

3-54. In response to the Interrupt, the Controller interrogates the status of the three possible interrupt peripherals to determine which generated the Interrupt signal. When the Printer Drive status is requested (by a binary coded 13 on Control Bus A) it responds by placing the Reset and TL-TP signal levels onto the Data Bus (via status response logic) as bits DB2 and DB3, respectively, thus, confirming that it initiated the Interrupt. When the Controller generates the next In strobe, it reads the confirming interrupt status code (binary coded 12) and then removes the status interrogation code from Control Bus A. As the status request line from the control bus decoder goes low, it resets the interrupt control logic and returns the Interrupt to a high level.

3-55. If the Controller is ready to supply data to the Printer Drive PCB when the Interrupt line returns high, it places a binary coded 5 onto the Control Bus A. The

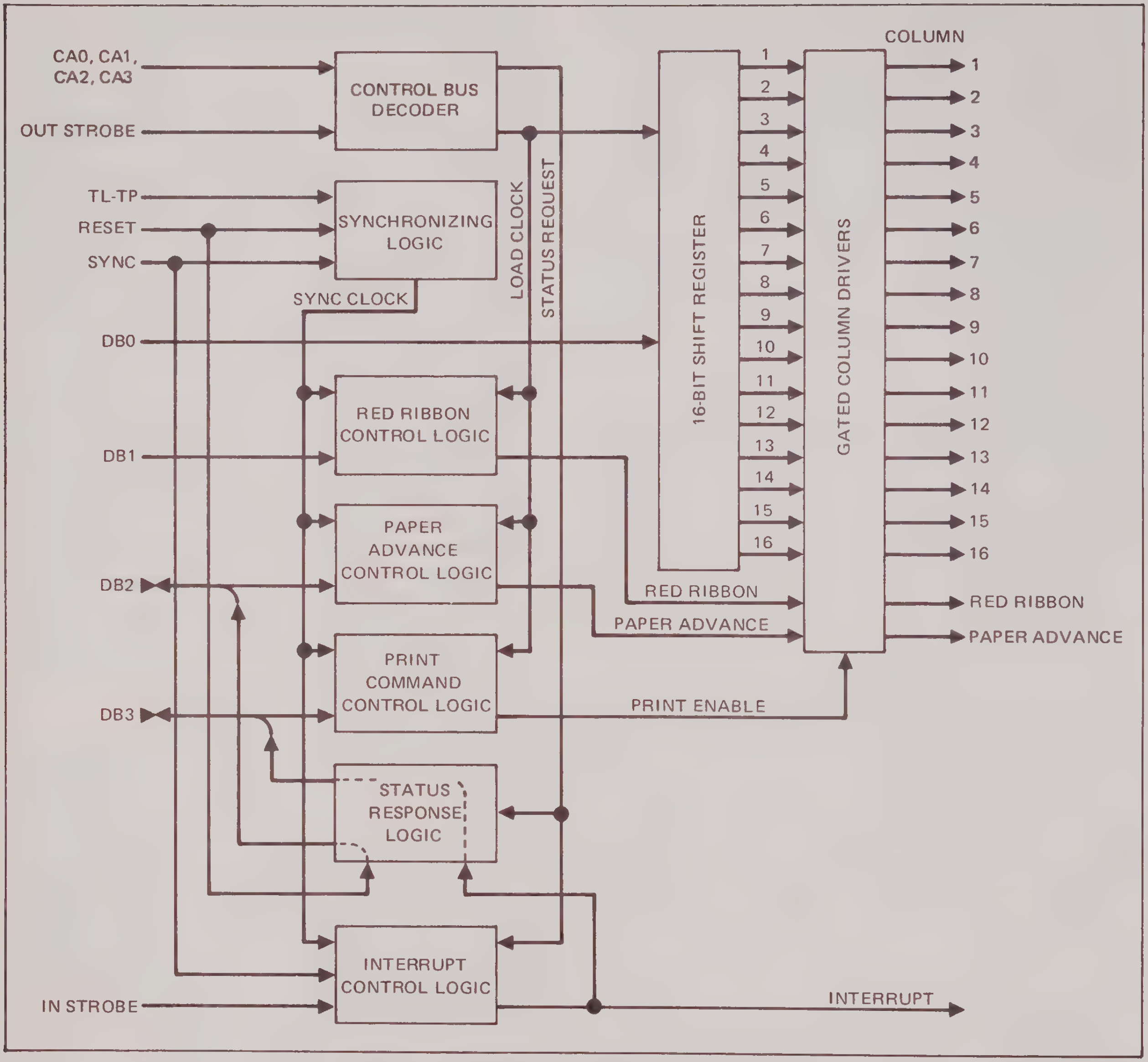

CA0, CA1, CA2, CA3
OUT STROBE
CONTROL BUS DECODER
TL-TP
RESET
SYNC
SYNCHRONIZING LOGIC
SYNC CLOCK
LOAD CLOCK
STATUS REQUEST
DB0
DB1
DB2
DB3
RED RIBBON CONTROL LOGIC
PAPER ADVANCE CONTROL LOGIC
PRINT COMMAND CONTROL LOGIC
STATUS RESPONSE LOGIC
INTERRUPT CONTROL LOGIC
IN STROBE
16-BIT SHIFT REGISTER
GATED COLUMN DRIVERS
COLUMN
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
RED RIBBON
PAPER ADVANCE
PRINT ENABLE
INTERRUPT

Figure 3-8. Printer Drive, Simplified Block Diagram

control bus decoder detects this code and enables the 16 subsequent Out strobes from the Controller to be accepted as a series of 16 Load clocks on the Printer Drive PCB Assembly. As each Load clock is accepted, the bit-serial data on DB0 is loaded into a 16-bit shift register. This stored data determines which print hammers, if any, will be activated while row 0 of the printer drum is under the print hammers. As the 16th data bit is presented to the shift register, Red Ribbon, Paper Advance, and Print Command data are received on DB1, DB2 and DB3, respectively. The subsequent Load clock shifts the last data bit into the 16-bit shift register, enters ribbon color data into the red ribbon control logic, and enters paper advance information into the paper advance control logic. On the trailing edge of the Load clock the print command control logic generates a Print Enable signal. This signal enables the gated column drivers to energize the appropriate print hammers and, thereby, print row 0 characters in the selected columns. The Printer also responds to the red ribbon and paper advance commands, when present. The Controller then removes the printer receive code from Control Bus A and waits for the next printer interrupt.

3-56. As the print drum continues to rotate, row 1 data is loaded into the shift register and the appropriate print hammers are energized. The sequence is performed a total of 13 times (once for each row on the printer drum) to complete a single print sequence.

3-57. Power Supply PCB Assembly

3-58. The Power Supply PCB Assembly, as shown in Figure 3-9, provides the operating voltages for the data logger and a full complement of options. It also provides the 1-second time interval marker (TIM) and the Power-On-Reset (POR) signal. TIM is used by the Controller to update the interval counter. POR is used to initialize the entire data logger when power is turned on or when a power interruption occurs.

3-59. Input power for the power supply is derived from a 115/230V ac power transformer with four secondary windings. Transformer line-power requirements (115/230V ac) are switch selectable through a switch mounted on the Power Supply PCB. Output windings are separated into two pairs by a transformer shield. Isolation between the pairs is maintained on both the Power Supply PCB and the data logger by including the shield as part of the data logger's guard circuit. As a result the data logger's operating voltages are classified as guarded and unguarded. Guarded voltages include +21 and -21V dc unregulated, and +5V dc regulated. Unguarded supplies include +5V dc, +16V dc and -10V dc; all of which are regulated and overload protected. The 1-second time base circuitry and the Power-On-Reset circuit are contained in the unguarded section of the power supply.

3-60. Conventional regulating techniques are used in both sections of the power supply. No voltage adjustments are required or included in the guarded section of the supply. In the unguarded section the -10V dc output serves as a reference voltage for both the +5V and +16V dc regulators. As a result, a single adjustment is provided for the -10V dc supply. When the -10V dc is calibrated the +5V and -16V dc supplies are automatically calibrated.

3-61. The 1-second time marker circuit consists of a switch selectable divide-by-50 or divide-by-60 IC whose input clock is derived from the ac voltage present at one of the transformer's secondary windings. When the IC is set to divide by the actual line frequency (50 or 60 Hz) it generates a 1 Hz pulse as an output. The pulse is buffered and serves as the 1-second time base (TIM) for use by the Controller in updating the interval counter.

3-62. The Power-On-Reset (POR) signal serves as a reset command to initialize the system when power is initially turned-on, or when line power is restored after a power failure. POR is generated by a fast-acting unregulated supply whose output is normally low during power off. When line power is initially applied, POR remains low for approximately 600 ms (reset period) and then goes high (+5V dc). The signal is adequately buffered for use in resetting all data logger logic.

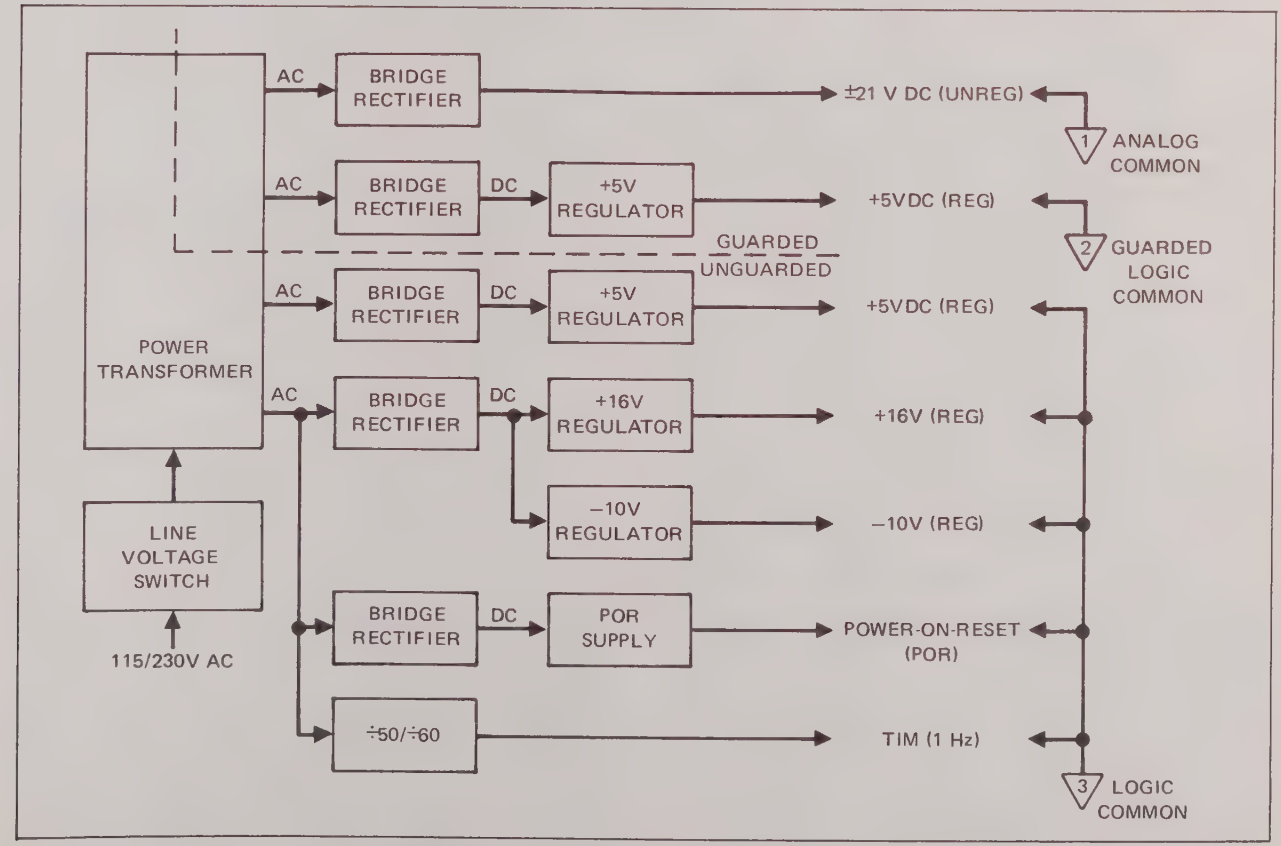


Figure 3-9. Power Supply, Simplified Block Diagram

3-63. Guard Crossing PCB Assembly

3-64. The Guard Crossing PCB Assembly operates in conjunction with the High Performance A/D Converter to provide the data logger with guarded, progammable, a/d voltage-measurement capability. Functions performed by the Guard Crossing PCB in this operation include: electrical isolation of the guarded input section of the data logger from the unguarded digital control section and digital control for the analog half of the dual-slope a/d converter (i.e., a/d control logic, crystal controlled clock and main counter string).

3-65. The Guard Crossing PCB Assembly, as shown in Figure 3-10, operates as a Controller peripheral and is capable of both receiving and transmitting data via the Data Bus. In the receive mode, channel and range programming data is accepted from the Controller, transferred across the guard crossing, and presented to the a/d converter. In the transmit mode, status or measurement data from the digital section of the a/d converter is transferred across the guard and presented to the Controller. The required operating mode is enabled when the appropriate address code is present on Control Bus A, and is executed under the direction of control signals received from the Controller.

3-66. The receive mode is enabled when the Controller places a binary coded 2 on Control Bus A. Input data from the Controller is received in character-serial format (four 4-bit characters) on the Data Bus (DB0 through DB3) and temporarily entered into storage in the channel and range latch by the Out strobe. Once stored, the character is optically transmitted across the guard, buffered and presented to the a/d converter as channel and range control data. As each character crosses the guard, it is followed by a 10 μs Receive clock. The clock is derived from the Out strobe and is generated by the receive clock logic. On the guarded side of the pcb, the Receive clock increments a four-bit shift register, the output of which, addresses range (S1) and channel storage (S2, S3 and S4) locations on the a/d converter. Data entered into these locations define the channel to be measured and the measurement range to be used.

3-67. The transmit status mode is enabled when the Controller places a binary coded 3 on Control Bus A. During the presence of this code, the control bus decoder generates a Status Enable signal which is used to perform three separate functions. First, it is transmitted across the guard where it is used to reset (initialize) both the transmit and receive address code shift registers. Second, it enables the tri-state drivers which allow transmitted data to be placed onto the Data Bus. Third, it allows the next In strobe to reset the Interrupt Logic and, thereby, clear the interrupt request line (IRQ).

3-68. When the tri-state drivers are enabled and the two address code registers are reset, status information is allowed to appear on the Data Bus as a single four-bit output character. Three separate characters are employed to indicate each of the following status conditions: measurement data ready, new channel and function data required for next measurement, and 1 μV signal. All three of these codes are derived from the a/d control logic portion of the Guard Crossing. The new-data-required and data-ready status conditions are keyed to the beginning and end, respectively, of each measurement cycle. The 1 μV signal is transmitted only once (during the initial power-on) and is used to inform the Controller the the High performance A/D Converter is installed.

3-69. When the a/d converter completes a measurement cycle it notifies the Controller by setting the Interrupt Logic and pulling the IRQ line low. The Controller responds by serially interrogating the status of the Printer Drive, the output options, and the Guard Crossing PCB Assemblies, to determine which of the three random responding units pulled the IRQ line low. When the Guard Crossing PCB is interrogated, it indicates that measurement data is ready to be transmitted. The Controller responds by terminating the status transmit mode and enabling the transmit data mode.

3-70. The transmit data mode is enabled when the Controller places a binary coded 1 on Control Bus A. While the code is present on the control bus, it causes the control bus decoder to generate a Transmit Enable signal. This signal, in turn, enables tri-state drivers and the transmit clock logic. The next In strobe from the Controller is passed through the transmit clock logic, coupled across the guard and used to set the first position of a five-bit shift register. Each subsequent In strobe is used to advance the shift register position and, thereby, sequentially address a five-channel multiplexer (main counter string and latches) in which measurement data is stored (MUX1-MUX5). As each channel of data is addressed (LSD first, MSD last), it is placed onto the guarded side of the data bus (B0 through B3), transmitted across the guard, and presented to the Data Bus through the enable tri-state drivers. Each character is read into the Controller on the trailing edge of the In strobe.

3-71. A/D Converter PCB Assembly

3-72. The High Performance A/D Converter PCB operates in conjunction with the Guard Crossing PCB to perform the analog functions of a five-range (40V, 4V, 400 mV, 80 mV and 40 mV), dual-slope, integrating DVM capable of resolving 1 μV on the 40 mV range. Digital program and control data necessary to complete a measurement cycle (this includes the read clock) are generated on the Guard Crossing PCB. Similarly, a 40,000 count counter string is included on the Guard Crossing PCB for accumulating the digital equivalent of

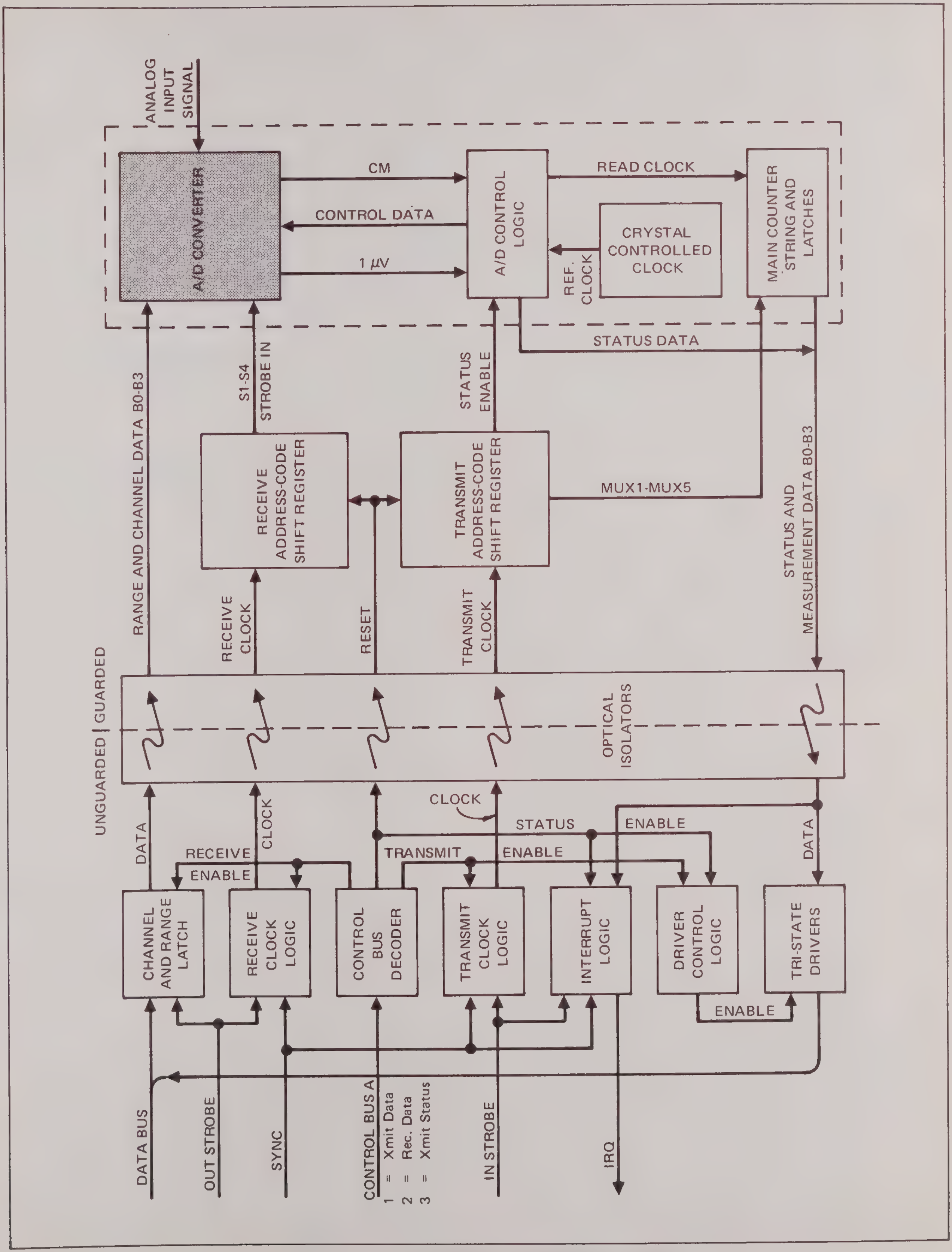

ANALOG INPUT SIGNAL
A/D CONVERTER
CM
CONTROL DATA
1 µV
A/D CONTROL LOGIC
READ CLOCK
CRYSTAL CONTROLLED CLOCK
REF. CLOCK
MAIN COUNTER STRING AND LATCHES
STATUS DATA
RANGE AND CHANNEL DATA B0-B3
S1-S4
STROBE IN
STATUS ENABLE
RECEIVE ADDRESS-CODE SHIFT REGISTER
TRANSMIT ADDRESS-CODE SHIFT REGISTER
MUX1-MUX5
STATUS AND MEASUREMENT DATA B0-B3
RECEIVE CLOCK
RESET
TRANSMIT CLOCK
UNGUARDED | GUARDED
OPTICAL ISOLATORS
DATA
CLOCK
RECEIVE
ENABLE
CLOCK
STATUS
ENABLE
TRANSMIT
ENABLE
DATA
CHANNEL AND RANGE LATCH
RECEIVE CLOCK LOGIC
CONTROL BUS DECODER
TRANSMIT CLOCK LOGIC
INTERRUPT LOGIC
DRIVER CONTROL LOGIC
TRI-STATE DRIVERS
ENABLE
DATA BUS
OUT STROBE
SYNC
CONTROL BUS A
1 = Xmit Data
2 = Rec. Data
3 = Xmit Status
IN STROBE
IRQ

Figure 3-10. Guard Crossing, Simplified Block Diagram

the measured analog input. After measurement data is accumulated, it is presented to the Data Bus in character-serial · format when solicited by the Controller. A simplified block diagram of the High Performance A/D Converter plus the associated digital logic from the Guard Crossing is given in Figure 3-11.

3-73. DIGITAL CONTROL LOGIC

3-74. Digital control logic for the High Performance A/D Converter is contained on both the Guard Crossing PCB and the A/D Converter PCB. A/D conversion logic on the Guard Crossing PCB consists of a two-speed crystal controlled clock, a digital counter with latches and multiplexed tri-state outputs, and dual-slope digital control logic. Digital logic on the High Performance A/D Converter PCB consists of four addressable four-bit registers and three output decoders. All digital input data utilized by the digital control logic is received from the Controller via the Guard Crossing PCB Assembly.

3-75. Operation of the guard crossing logic is synchronized with the output of the crystal controlled clock. The clock in turn is synchronized with the line frequency to optimize the common mode and normal mode rejection characteristics of the a/d converter. This is accomplished by installing either a 2 MHz or 2.4 MHz crystal for 50 or 60 Hz line frequencies, respectively. Additional clock circuitry in the form of pulse shaping dividers produce the final 2 phase reference clock as received by the dual-slope control logic.

3-76. Clock rate (and, therefore, measurement speed) can be selected manually by positioning a FAST/SLOW slide switch on the A/D Converter PCB. In the fast position a 1.2 MHz (60 Hz), 2 phase clock is supplied directly to the a/d converter logic. Since a measurement cycle requires 80,000 clock pulses to produce a reading, the a/d converter can accomplish a maximum of 15 readings per second. In the slow switch position the 1.2 MHz clock is divided by five. Thus, the measurement rate is reduced to three readings per second, maximum.

3-77. Overall timing of the dual-slope conversion process is governed directly by the dual-slope control logic. Two control flip-flops (U14B/FFA and U20A/FFB) operate in response to the carry outputs of the various counter stages and the reference clock to determine the next state of the dual-slope control logic and, therefore, its output control signals. These signals are shown in Figure 3-12 and described in Table 3-3.

3-78. The data accumulated in the digital counter (if ⩽39999) is determined to be the digital equivalent of the analog input voltage when the CM (compare) input from the A/D Converter PCB transitions to a state which is the opposite of the POL (polarity) level. This transition indicates the end of the read period and causes the counter data to be loaded into the output latches. It also initiates a Data Ready signal which is transmitted across the guard as a part of the status word.

3-79. When the Controller detects the Data Ready status it generates a series of five In Strobe pulses which are converted on the Guard Crossing PCB into a series of five mulitplexer pulses, MUX1 through MUX5. As each pulse sequentially occurs, one of the five 4-bit counter characters is solicited, transferred across the guard crossing, and placed onto the Controller's Data Bus. The entire five measurement digits (this includes polarity and overload indications as part of the MSD) must be transmitted across the guard before the next measurement cycle is allowed to start (i.e., the reference clock in inhibited until MUX5 goes low to indicate that the last digit of measurement data has been solicited).

3-80. Channel select data for measurement purposes is updated once during each a/d conversion (measurement) cycle so that new analog data can be presented to the A/D Converter. Updating occurs in response to an interrupt status signal generated by the Guard Crossing PCB, the interrupt causes the Controller to specify the next programmed measurement channel and its associated function data to the Guard Crossing PCB. Data is received as a series of four 4-bit characters which are serially transferred across the guard to the A/D Converter PCB. A unique strobe pulse (S1 through S4) accompanies each character and causes it to be entered into a four bit register. The first character is entered into a range and function register by strobe pulse S1. The second, third and fourth characters are similarly entered into a series of three channel select registers by strobe pulses S2, S3 and S4, respectively.

3-81. Range and function data for the next measurement cycle are derived from the first stored character. Its two low-order bits D0 and D1 are decoded to provide the range command (4V, 400 mV, 80 mV, 40 mV) for the Range Amplifier on the A/D Converter PCB. Similarly, the 40V range, open-thermocouple detect, and reference-junction measure commands are decoded from the two high-order bits, D2 and D3.

3-82. Channel select commands (units, tens and hundreds) are taken directly from the output of the three channnel select registers. Tens data is decoded to provide the individual block register select commands for the first 60 (0-59) channels in the data logger, while units data activates the appropriate channel relay (0-9) in the selected scanner block. Commands above 59 (60 through 99) are available at a rear panel connector on the A/D Converter PCB for use in selecting channels mainitained in an external scanner chassis (2201A, 2202A and/or 2203A).

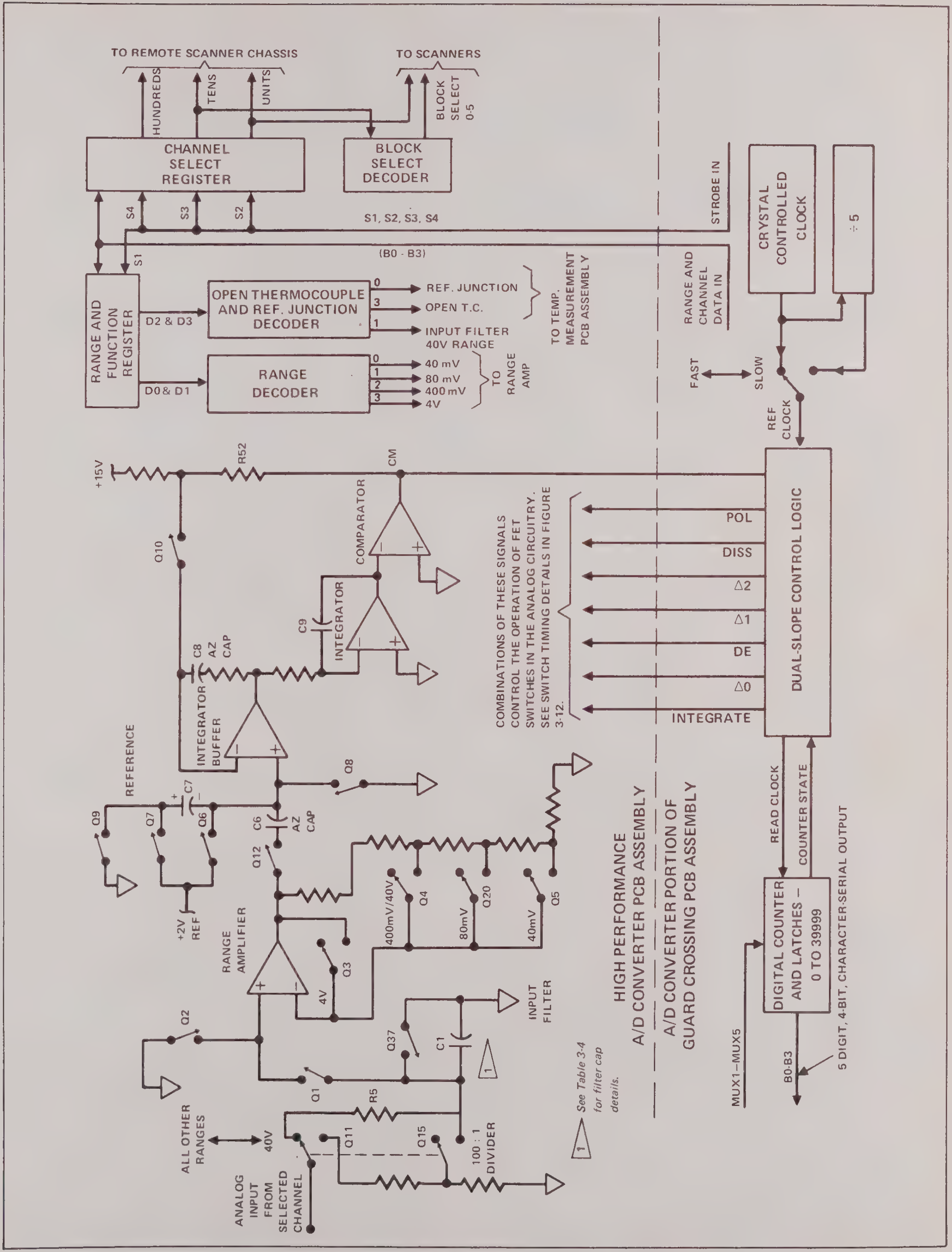

TO REMOTE SCANNER CHASSIS
HUNDREDS
TENS
UNITS
TO SCANNERS
BLOCK SELECT 0-5
CHANNEL SELECT REGISTER
BLOCK SELECT DECODER
S4
S3
S2
S1
S1, S2, S3, S4
(B0 - B3)
STROBE IN
RANGE AND CHANNEL DATA IN
CRYSTAL CONTROLLED CLOCK
÷ 5
RANGE AND FUNCTION REGISTER
D2 & D3
D0 & D1
OPEN THERMOCOUPLE AND REF. JUNCTION DECODER
0
3
1
REF. JUNCTION
OPEN T.C.
INPUT FILTER 40V RANGE
TO TEMP. MEASUREMENT PCB ASSEMBLY
RANGE DECODER
0
1
2
3
40 mV
80 mV
400 mV
4V
TO RANGE AMP
FAST
SLOW
REF CLOCK
+15V
R52
CM
COMPARATOR
Q10
C9
INTEGRATOR
C8 AZ CAP
INTEGRATOR BUFFER
REFERENCE
Q8
C7
Q9
Q7
Q6
C6 AZ CAP
+2V REF
Q12
RANGE AMPLIFIER
Q3
4V
400mV/40V
Q4
80mV
Q20
40mV
Q5
Q2
Q37
C1
INPUT FILTER
1
Q1
R5
ALL OTHER RANGES
40V
Q11
Q15
100 : 1 DIVIDER
ANALOG INPUT FROM SELECTED CHANNEL
COMBINATIONS OF THESE SIGNALS CONTROL THE OPERATION OF FET SWITCHES IN THE ANALOG CIRCUITRY. SEE SWITCH TIMING DETAILS IN FIGURE 3-12.
POL
DISS
Δ2
Δ1
DE
Δ0
INTEGRATE
DUAL-SLOPE CONTROL LOGIC
READ CLOCK
COUNTER STATE
DIGITAL COUNTER AND LATCHES – 0 TO 39999
MUX1–MUX5
B0-B3
5 DIGIT, 4-BIT, CHARACTER-SERIAL OUTPUT
HIGH PERFORMANCE A/D CONVERTER PCB ASSEMBLY
A/D CONVERTER PORTION OF GUARD CROSSING PCB ASSEMBLY
1 See Table 3-4 for filter cap details.

Figure 3-11. A/D Converter, Functional Block Diagram

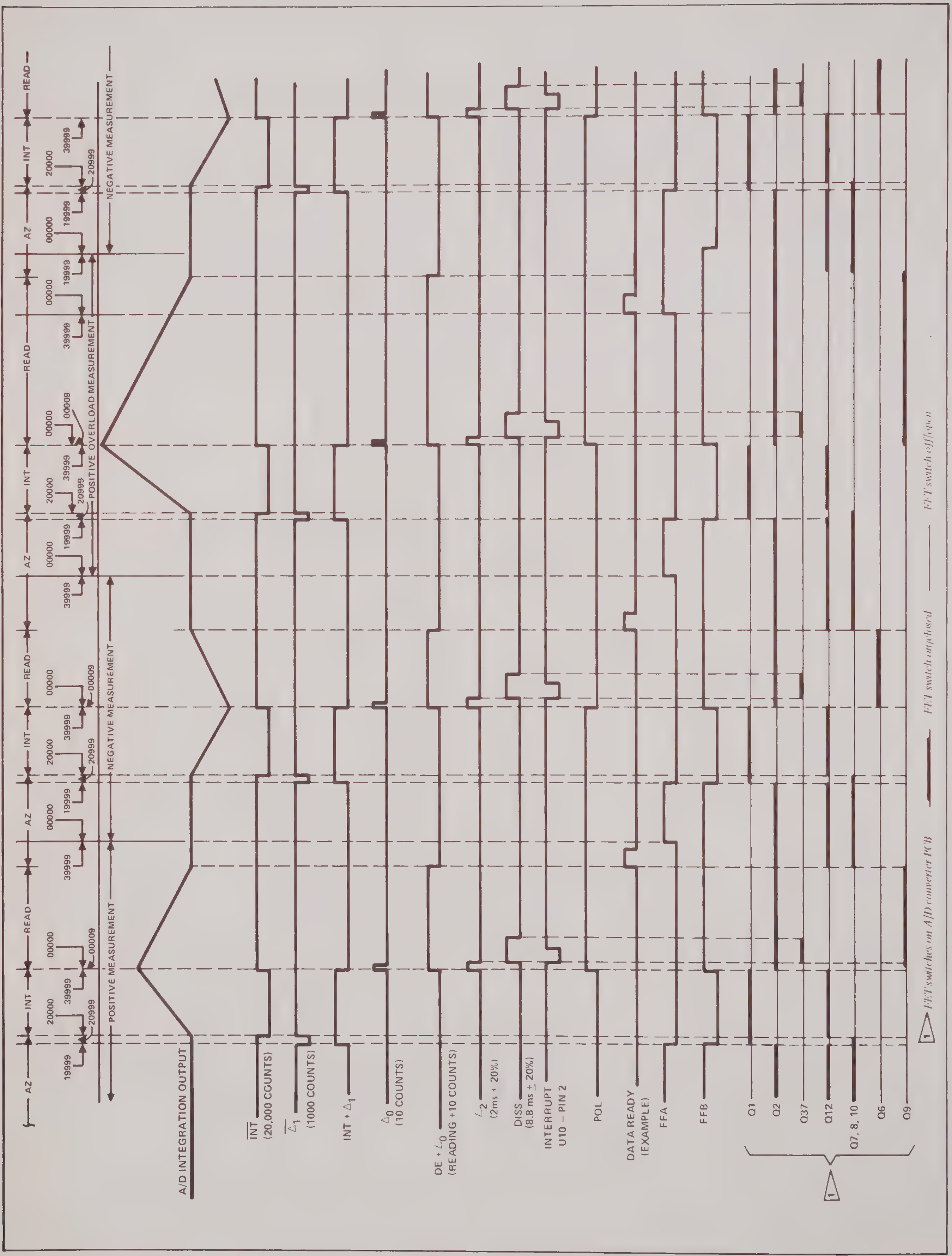

AZ
INT
READ
19999
20000
39999
20999
00000
00009
POSITIVE MEASUREMENT
NEGATIVE MEASUREMENT
POSITIVE OVERLOAD MEASUREMENT
A/D INTEGRATION OUTPUT
INT (20,000 COUNTS)
Δ1 (1000 COUNTS)
INT + Δ1
Δ0 (10 COUNTS)
DE + Δ0 (READING +10 COUNTS)
Δ2 (2ms + 20%)
DISS (8.8 ms ± 20%)
INTERRUPT U10 – PIN 2
POL
DATA READY (EXAMPLE)
FFA
FFB
Q1
Q2
Q37
Q12
Q7, 8, 10
Q6
Q9
1
1 FET switches on A/D converter PCB
FET switch on/closed
FET switch off/open

Figure 3-12. A/D Converter, Timing Diagram

Table 3-3. Guard Crossing Signal Descriptions

SIGNAL NAME	DESCRIPTION
Int + △1	A 2100 count period derived directly from control flip-flop FFB (U20A). Used for controlling FET switching on the A/D Converter PCB.
△1	A 1000 count period which starts when FAA and FFB are both low and the counter has reached a count of 19999. The period ends when the counter three least-significant stages go through a count of 999. At this time the fourth stage is prevented from clocking so that the clock pulse will change the counter from 20999 to 20000. This signals the beginning of the integrate period.
△0	A 10 count period immediately following the end of the integrate period. During this time the second counter stage is inhibited so that the count goes from 39999 to 00009 and then to 00000. Thus, after a 10 count settling period the read period starts at a count of 00000 and continues on. The count at the end of the read period is proportional to the analog input voltage.
POL	Indicates the polarity of the integrated input signal, and is derived form the level (high or low) of the CM signal at the end of the integrate period.
△2	A 2 ms pulse generated at the end of the integrate period. It is used by the Temperature and Scaling Circuit to trigger an open thermocouple detector.
Diss	An 8.8 ms pulse generated at the end of △2. It is used to discharge the input filter before the next analog input is applied and to prevent the closing of more than 1 scanner relay at a time.
DE	A variable length read period which begins at the end of the △0 pulse. The end of the read period occurs when the CMpulse transitions to a state that is different from POL or when the counter counts through 19999 after an overload reading of 39999.
OL (Overload)	An overload signal (1-bit) which is returned to the controller with the MSD of measurement data. The signal occurs when the counter counts through 39999 before a CM input transition occurs, and prevents the counter MSD from going from 19999 to 20000. Instead, the counter transitions from 19999 to 00000. This allows an extra 20000 count auto-zero period to ensure full recovery from the overload condition.

3-83. ANALOG CIRCUIT

3-84. The analog portion of the dual-slope a/d converter is contained entirely on the High Performance A/D Converter PCB Assembly. It consists of an input filter, a range amplifier, a reference supply, an integrator buffer, a comparator and a series of FET switches. Digital control signals from the Guard Crossing PCB control the operation of the FET switches and, therefore, the overall operation of the analog circuit. Figure 3-12 relates the operation of each individual FET switch to the digitally controlled measurement cycle.

3-85. Operation of any given measurement cycle can be logically divided into three measurement periods; auto zero, integrate, and read. Auto zero is used to measure and eliminate any in circuit errors which might influence the end reading. Integrate allows the input signal to be sampled (integrated) for a known time period. During the read period two separate functions are performed; the next analog input is applied to the input filter for settling purposes, and the previously sampled (integrate) input voltage is compared (integrated) against a reference voltage. The time required to complete the read period is then translated, by the dual-slope control logic, into a digital equivalent of the analog input voltage.

3-86. The auto zero period begins at the end of the read period, as indicated by the leading edge of the Data Ready pulse. At that time FET switches Q1, Q37, Q6 and Q9 are open and Q2, Q7, Q8, Q10 and Q12 are closed. Switch Q1 isolates the input of the range amplifier from the analog level present at the input filter. Switches Q2 and Q8 provide a zero volt reference levels for charging a series of reference capacitors C6, C7 and C8. Capacitor C6 charges through Q8 and Q12 to a value which is equal to the offset voltage error inherent in the Range Amplifier. Similarly, capacitor C8 is charged through switch Q10 to a value which is equal to the loop offset voltage of the integrator buffer, integrator and comparator combination. Finally, capacitor C7 is charged to the +2V reference level through switches Q7 and Q8. The charges on these capacitors will be retained throughout the remainder of the measurement cycle for use in eliminating offset errors (C6 and C8), and providing the choice of selectable reference polarity (C7) which is compatible with the analog input signal.

3-87. Termination of the auto zero period occurs in two steps. First switches Q2 and Q12 are opened and switch Q1 is closed. This isolates the range amplifier output from the rest of the circuit and allows it to respond to the input voltage applied through switch Q1. Second, switches Q7, Q8 and Q10 are opened and switch Q12 is closed. This connects the output of the range amplifier to the integrator buffer. At this time, the auto zero period is ended and the integrate period begins.

3-88. During the integrate period the integrator buffer presents the integrator with an offset-corrected dc input voltage which is equivalent to the analog input voltage level. This signal is then integrated for a fixed time which is equal to 20,000 read-clock pulses, as determined by the digital counters on the Guard Crossing PCB. When the time period is satisfied the integrate period is ended and the read period is started.

3-89. At the start of the read period, switches Q1 and Q12 are opened, and Q2 and either Q6 or Q9 are closed. Switches Q1, Q2 and Q12 electrically remove the range amplifier and, therefore, the analog input signal from the input of the integrator buffer via the previously charged reference capacitor C7. However, if the original analog input signal was negative, switch Q6 is closed causing the +2 volt reference to be applied directly the input of the integrator buffer. In either event, integrator capacitor C9 begins to discharge at a fixed linear rate, and the counter string on the Guard Crossing PCB begins to count and accumulates the reference clock output. The discharge continues until the capacitor reaches a zero-charge level as determined by the previous auto-zero period. When that level is detected by the comparator, a compare (CM) transition is generated to terminate the read period. This stops the counter on the Guard Crossing PCB and returns the analog circuitry to the auto-zero period. (The next measurement cycle starts after data is transferred across the guard to the Controller.)

3-90. Since the range amplifier and the input filter are isolated from the rest of the analog circuit at the beginning of the read period, both digital range data and the analog input signal for the next measurement channel are entered at that time. This allows both the input filter and the range amplifier to settle before the next measurement cycle begins.

3-91. The input filter is a single pole RC filter designed to suppress noise which accompanies the input signal. On all ranges, except 40V, resistor R5 acts as the primary resistive component. The capacitive component varies as a function of both measurement speed (fast/slow) and selected range. On the 40V range, resistor R5 is switched out of the input circuit by relay, K1 and is replaced by a 100:1 divider. On the 40 mV and 80 mV ranges, separate capacitors, as well as, active clamp circuitry (U25) are switched into the circuit. Table 3-4 defines each of the input filter capacitors, as well as, which capacitor(s) is (are) selected for any given combination of range and measurement speed.

Table 3-4. Input Filter Capacitors

FILTER CAPACITOR	VALUE μF	APPLICABLE RANGE AND SPEED (FAST OR SLOW)				
		40V	4V	400 mV	80 mV	40 mV
C1	0.033	F&S	F&S	F&S	–	–
C14	0.033		F&S	F&S	–	–
C2	0.22		S	S	–	–
C15	0.22	S	S	S	–	–
C20	0.068	–	–	–	F&S	F&S
C21	0.39	–	–	–	S	S

3-92. Temperature and Scaling Circuit

3-93. The Temperature and Scaling Circuit operates as an extension of the A/D Converter to provide direct-reading temperature measurements using thermocouple probes. It consists of a Temperature Measurement PCB, a linearization ROM and a configuration PROM. The Temperature Measurement PCB mounts on the A/D Converter as plug-in subassembly and provides the analog switching necessary for open thermocouple detection as well as reference junction measurement. Both the ROM and the PROM plug into sockets provided on the Controller PCB. The linearization ROM contains the linearization program for the microprocessor and the linearization tables for thermocouple types, J, K, R, S and T. The configuration PROM relates the front panel function switches (T1, T2, T3 and T4) to the proper linearization table and A/D Converter range. See Table 3-5.

3-94. When a temperature measurement is made the processor first calls for a reference junction measurement to determine the temperature of the terminal block on the measurement channel's Isothermal Block Connector. Since this temperature is the same for all thermocouples associated with the block connector, only one measurement is required each time the block channels are

Table 3-5. Definition of Configuration PROM Address Codes and Output Codes

ADDRESS FUNCTION	PROM LOCATION	OUTPUT DATA B_3 B_2 B_1 B_0	OUTPUT CODES
Indicates that temperature and scaling circuit are installed	00	0 0 0 0	0000 dentoes that function T1, T2, T3, T4 are in system
Not Used	01 02 03		Not used
Determine display annotation codes and decimal point location codes	04 05 06 07 08 09 0A 0B	T1 Decimal Point T1 Display Code T2 Decimal Point T2 Display Code T3 Decimal Point T3 Display Code T4 Decimal Point T4 Display Code	Display Code B_3 B_2 B_1 B_0 1 0 1 0 Temperature 1 0 1 1 mV 1 1 0 0 V 1 1 0 1 Time 1 1 1 1 (Blank) Decimal Point B_3 B_2 B_1 B_0 0 0 0 0 XXXX.X 0 0 1 0 XXX.XX 0 0 1 1 XX.XXX 0 1 0 0 X.XXXX / / / / XXXXX
Determine the A/D range codes	0C 0D 0E 0F	T1 A/D Range T2 A/D Range T3 A/D Range T4 A/D Range	B_3 B_2 B_1 B_0 Reference Junction 0 0 1 1 40 mV Temp. 1 1 0 0 80 mV Temp. 1 1 0 1 400 mV Temp. 1 1 1 1 B_3 B_2 B_1 B_0 40 mV 1 0 0 0 80 mV 1 0 0 1 400 mV 1 0 1 0 4V 1 0 1 1 40V 0 1 1 0
Determine the transducer personality codes	10 11 12 13	T1 Personality T2 Personality T3 Personality T4 Personality	B3 = 1 ⇒linearize A/D reading B3 = 0 = no linearization B2 = 1 ⇒round up least significant digit and blank it for display if A/D is 10 μV type (e.g., 1° temperature) B1 = 0 ⇒allow linearization program to make °C to °F conversion based on °C/°F select switch, B1 = 1 ⇒ force °C linearization B0 = 0 ⇒allow A/D type flag to linearization B0 = 1 ⇒force 1 μV
Determine the printer annotation codes	14 15 16 17 18 19 1A 1B	T1 R. Annunciator T1 L. Annunciator T2 R. Annunciator T2 L. Annunciator T3 R. Annunciator T3 L. Annunciator T4 R. Annunciator T4 L. Annunciator	B_3 B_2 B_1 B_0 Left Annunciator Right Annunciator 0 0 0 0 DC V 0 0 0 1 AC Ω 0 0 1 0 k lb 0 0 1 1 M Hz 0 1 0 0 m s 0 1 0 1 P C^2 0 1 1 0 °C % 0 1 1 1 °F si 1 0 0 0 dB F 1 0 0 1 μ W 1 0 1 0 G A 1 0 1 1 (Blank) (Blank) 1 1 0 0 kg mA 1 1 0 1 (Blank) (Blank) 1 1 1 0 (Blank) (Blank) 1 1 1 1 (Blank) (Blank)
Determine where the linearization coefficient data base is located	1C 1D 1E 1F	T1 Coef. Location T2 Coef. Location T3 Coef. Location T4 Coef. Location	For Temperature and Scaling B_3 B_2 B_1 B_0 0 0 0 0 Controller U5 ROM Page 3 0 0 1 0 Controller U5 ROM Page 4 0 1 0 0 Controller U5 ROM Page 5 0 1 1 0 Controller U5 ROM Page 6 1 0 0 0 Controller U5 ROM Page 7 1 0 1 0 Controller U11 PROM Socket

scanned. Measured reference junction data is then sent to the microprocessor where it is used to derive a voltage offset which is the difference between the voltage generated at the thermocouple termination at ambient temperature and the terminal voltage which would be observed at 0°C. (The difference is due to the thermocouple effect at the terminal block where a transition is made from thermocouple wire alloys to copper.) This voltage is then added to each subsequently measured thermocouple voltage at the Isothermal Block Connector. The result is a thermocouple output relative to a terminal point temperature of 0°C. Finally the corrected thermocouple voltage is converted, via a piecewise linear approximation (linearization ROM), into an equivalent temperature which is subsequently displayed. A resolution of 0.1°C (1 or 2 μV) is obtained using the High Performance A/D Converter.

3-95. Temperature Measurement PCB Assembly

3-96. The operation of the Temperature Measurement PCB can be divided into three separate functions; open thermocouple detector, reference voltage buffer and reference junction measurement. Refer to the Temperature Measurement PCB schematic diagram in Section 8 to supplement to the following description.

3-97. Open thermocouple detection is enabled when the measurement function is programmed for a thermocouple temperature measurement (T1, T2, T3 and T4). The enabling program data bit is stored in the function register on the A/D Converter PCB and is delivered to the Temperature Measurement PCB as a low signal via the T (temperature) input. At the end of the A/D Converter's integration period (during 2) relay K2 is energized and R-S flip-flop (U1B and U1C) is preset. The closed contacts of K2 allows the flip-flop to observe the condition of the input thermocouple, and reset if a normally low impedance is encountered (7.5 ±2.5 kΩ). Otherwise the flip-flop will remain in the preset condition and generate an open-thermocouple indication (open TC low). At the beginning of the read portion of the measurement cycle the 2 pulse returns low allowing relay K2 to open. This allows the flip-flop to remain latched in its current position until changed during subsequent temperature measurement cycles.

3-98. The reference voltage used to power the reference junction circuitry on the Isothermal Block Connectors (Option -08) is derived from the 6.2V reference on the A/D Converter PCB. A unity gain amplifier on the Temperature Measurement PCB buffers the reference voltage and drives the 6.2V bus which supplies operating power to the Isothermal Block Connectors housed in both the data logger and the extender chassis.

3-99. When the reference junction is to be measured, input RJ (from the function register on the A/D Converter) is driven low causing the dpst contacts to relay K1 to close. As a result the output of the reference voltage amplifier is connected to the 6.2V reference bus. A return signal in the form of reference junction temperature from the enabled Isothermal Block Connector (Option -08) is presented to the A/D Converter for measurement purposes through the other pair of relay contacts.

3-100. Low Level Scanner

3-101. The Low Level Scanner is described in detail in Section 6 of this manual. See Option -06.

3-102. Isothermal Block Connector

3-103. The Isothermal Block Connector is described in detail in Section 6 of this manual. See Option -08.

Section 4

Maintenance

WARNING

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4-1. INTRODUCTION

4-2. This section of the manual contains maintenance information for the Model 2200B Data Logger. This includes service information, general maintenance, performance test and calibration. The performance test is recommended as an acceptance test when the instrument is first received, and later as a preventive maintenance tool to verify proper operation, when necessary. A calibration cycle of 1 year is recommended to maintain the 2200B within the 1 year specifications. If the 90 day specifications are to be maintained, a 90 day calibration cycle is recommended. Table 4-1 lists the recommended test equipment necessary to execute the performance test and calibration procedures. If the specified equipment is not available, alternate equipment having equivalent specifications may be substituted.

4-3. SERVICE INFORMATION

4-4. The 2200B is warranted for a period of 1 year upon delivery to the original purchaser. The WARRANTY is given on the back of the title page located in the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various worldwide locations. A complete list of these service centers is included with the WARRANTY. Shipping information is given in Section 2 of the manual. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

Table 4-1. Test Equipment Required

INSTRUMENT TYPE	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DC Voltage Calibrator	40 mV to 40V dc output, ±0.002%	Fluke Model 343A
DC Voltmeter	0 to 40V dc, ±(0.1% of reading + 1 digit)	Fluke Model 8000A

4-6. GENERAL MAINTENANCE

4-7. Access Information

WARNING

LETHAL VOLTAGES MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2200B IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNER PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

4-8. CALIBRATION ADJUSTMENTS

4-9. All calibration adjustments and all plug-in options within the data logger can be accessed for maintenance purposes by removing the top dust cover and the two inner covers located in the top-rear of the instrument. Six Phillips head screws hold the top dust cover in place.

4-10. A/D CONVERTER

4-11. The A/D Converter is accessed by removing the top dust cover, and the inner guard cover from the data logger.The position of the A/D Converter in the data logger is shown in Figure 4-1. Access to the calibration adjustments does not require the removal of the guard cover. The test points referred to in the calibration procedure are accessible through the rear panel.

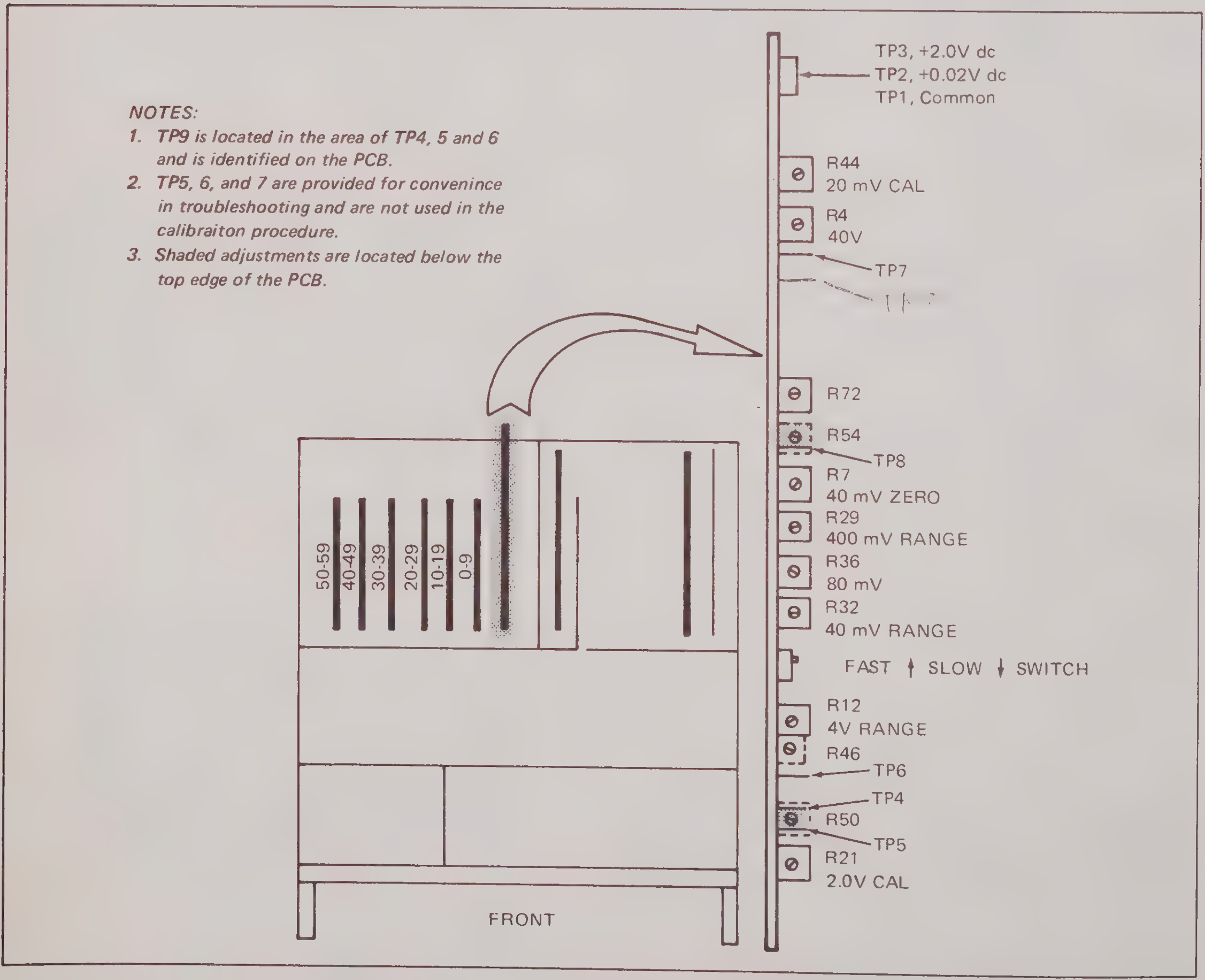
CAUTION

Handle the A/D Converter PCB by its edges to avoid contaminating it with oil from the hands. The use of gloves is recommended when handling the PCB.

4-12. To remove the A/D Converter from the data logger, remove the inner guard cover and disconnect the rear-panel scanner-chassis cable connector from the A/D Converter (this connector is present only if the data logger is equipped with the Scanner Chassis, Model 2201A, 2202A and 2203A). Pull the A/D Converter PCB straight up and out through the top of the data logger.

4-13. TEMPERATURE AND SCALING COMPONENTS

4-14. The Temperature and Scaling Option comprises one pcb assembly and two IC's. These components are installed in two separate locations in the data logger and can be easily accessed for maintenance purposes. Figure 4-2 defines the individual component locations of both the Controller and A/D Converter PCB's. Access to these pcb's is achieved by removing the top cover and the two inner guard covers from the data logger.



NOTES:

1. *TP9 is located in the area of TP4, 5 and 6 and is identified on the PCB.*
2. *TP5, 6, and 7 are provided for convenince in troubleshooting and are not used in the calibraiton procedure.*
3. *Shaded adjustments are located below the top edge of the PCB.*

TP3, +2.0V dc
TP2, +0.02V dc
TP1, Common
R44
20 mV CAL
R4
40V
TP7
R72
R54
TP8
R7
40 mV ZERO
R29
400 mV RANGE
R36
80 mV
R32
40 mV RANGE
FAST ↑ SLOW ↓ SWITCH
R12
4V RANGE
R46
TP6
TP4
R50
TP5
R21
2.0V CAL
50-59
40-49
30-39
20-29
10-19
0-9
FRONT

Figure 4-1. A/D Converter Test Point and Adjustment Locations

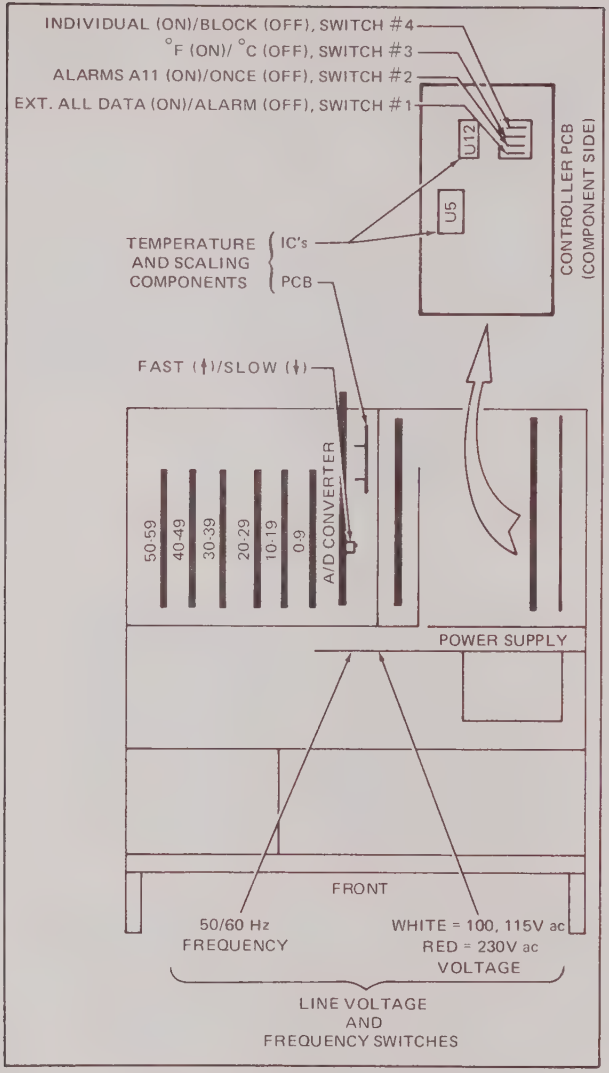

INDIVIDUAL (ON)/BLOCK (OFF), SWITCH #4
°F (ON)/ °C (OFF), SWITCH #3
ALARMS A11 (ON)/ONCE (OFF), SWITCH #2
EXT. ALL DATA (ON)/ALARM (OFF), SWITCH #1
U12
U5
CONTROLLER PCB (COMPONENT SIDE)
TEMPERATURE AND SCALING COMPONENTS
IC's
PCB
FAST (↑)/SLOW (↓)
50-59
40-49
30-39
20-29
10-19
0-9
A/D CONVERTER
POWER SUPPLY
FRONT
50/60 Hz FREQUENCY
WHITE = 100, 115V ac
RED = 230V ac
VOLTAGE
LINE VOLTAGE AND FREQUENCY SWITCHES

Figure 4-2. Access Information

4-15. SEIKO MODEL 102 PRINTER HEAD

4-16. Use the following procedure to remove the printer head from the 2200B:

1. Remove the top dust cover from the 2200B.

2. Locate the hinges on the printer's front panel assembly and, with the panel closed, apply pressure, using a thumb or finger, to the rear of one of the hinges. The hinge will snap apart.

3. Using a lateral motion, separate the other hinge and remove the printer's front panel.

4. Disconnect the printer's cable and connector assembly from the Printer Drive PCB. (The cable is located at the bottom of the printer bulkhead.)

5. Remove the four large mounting screws at the rear of the printer bulkhead. Support the printer with one hand while removing these screws. (The use of an offset Phillips-head screwdriver is suggested.)

6. Fully extend the paper drawer and work the top of the printer through the front panel opening.

7. Push the cable through the bulkhead bushing and cable clamp to obtain about 4 to 5 inches of free cable at the printer.

8. Remove the printer's cable clamp and cable bushing from the bulkhead.

9. Remove the cable from the bushing-slot and slide both the cable and connector past the extended printer drawer.

10. Logically reverse this procedure to install the printer head.

4-17. Cleaning

4-18. Clean the Model 2200B periodically to remove dust, grease and other contamination. Separate procedures are given below for cleaning the Seiko Model 102 Printer Head and the 2200B cables and pcb's.

4-19. SEIKO MODEL 102 PRINTER HEAD

4-20. The printer should be cleaned after using 10 packs of paper or every 90 days. Use the following procedure:

1. Remove the printer head from the chassis using the procedure given earlier in this section.

2. Use a brush or vacuum cleaner to remove dust and other clinging particles.

3. Clean the face of the print drum using a hard bristle brush.

4. Use alcohol or benzine to remove grease and grime from the printer.

CAUTION

The use of thinner, trichlorethelene, ketone, etc., may cause damage to plastic parts on the printer.

4-21. CABLES AND PCB'S

4-22. Use the following procedure to clean the interface cables and pcb's used with the data logger.

1. Clean the cables with a soft cloth dampened with a mild solution of detergent and water.

2. Clean the surface of the pcb's using clean, dry air at low pressure (≤20 psi). If grease is encountered, spray with Freon T.F. Degreaser and remove grime with clean, dry air at low pressure.

4-23. Lubrication

4-24. The Seiko Model 102 Printer should be lubricated every 6 months under normal use conditions and, if necessary, after cleaning. Refer to Figure 4-3 and apply the specified lubricant, O2 or G2, to the points indicated. Use a syringe for hard-to-reach lubrication points.

NOTE

The required lubricants, O2 and G2, can be purchased from: C. Itoh and Co., Tel: 213-390-7778.

4-25. Internal Switch Settings

4-26. A series of switches on the inside of the 2200B allows the user to select and, thereby, define certain 2200B operating characteristics. These include: temperature scale (°C/°F), programming mode (individual/block), format of printed and/or recorded data (alarm all/once), measurement speed (fast/slow), and line voltage and frequency. Figure 4-2 identifies each of the switch locations. Procedures for setting the switches are given in the following paragraphs.

4-27. TEMPERATURE SCALE (°C/°F)

4-28. Temperature measurements can be switch selected for display (and reading) in either °C or °F. Set switch 3 on the Controller PCB Assembly to ON for the °F scale or OFF for the °C scale. See Figure 4-2.

4-29. INDIVIDUAL/BLOCK PROGRAMMING

4-30. The individual or block programming mode, as described in Section 2 of this manual, can be selected by setting switch 4 on the Controller PCB Assembly; ON selects the individual mode, and OFF selects the block mode. See Figure 4-2.

4-31. PRINT/RECORD FORMAT

4-32. The data formats for recorded data, as described in Section 2 of this manual, can be selected by setting switches 1 and 2 on the Controller PCB Assembly.See Figure 4-2. To format externally recorded data, set switch 1 to ON for all data, or to OFF for alarm data. printed data format is selected by setting switch 2 to ON for all alarms, or to OFF for alarm once.

4-33. MEASUREMENT SPEED (FAST/SLOW)

4-34. The free-run measurement speed of the A/D Converter (i.e., no interruptions for recording data) is switch selectable at either 3 or 15 readings per second. Selection is accomplished by manually positioning a fast/slow switch which is located on the top-edge of the High Performance A/D Converter PCB Assembly. Figure 4-1 defines the switch location as well as the fast/slow positions.

4-35. INPUT POWER SELECTION

WARNING

LETHAL VOLTAGE MAY BE PRESENT AT THE LINE POWER INPUT CONNECTOR AND THE POWER SUPPLY PCB ASSEMBLY WHEN THE 2200B IS CONNECTED TO LINE POWER. LETHAL COMMON MODE VOLTAGES MAY ALSO BE PRESENT AT THE SCANNER INPUT CONNECTORS AND SCANNER PCB'S EVEN THOUGH THE LINE POWER CORD IS DISCONNECTED.

4-36. The 2200B can be operated from either 100, 115, 230V ac, 50 or 60 Hz line power depending upon the combination specified at the time of purchase. Before connecting the 2200B to line power, check and, if necessary, set the line voltage and the line frequency switches on the Power Supply PCB as follows:

1. Remove the top dust cover from the instrument.

2. Locate the line voltage switch shown in Figure 4-2.

3. Refer to the rear panel decal and use a screwdriver to set the slide switch so that the specified voltage (100/115 [white] or 230V ac [red]) appears in the slide aperature.

4. Locate the line frequency switch shown in Figure 4-2.

5. Set the switch to the line frequency (50 to 60 Hz) specified on the rear panel decal.

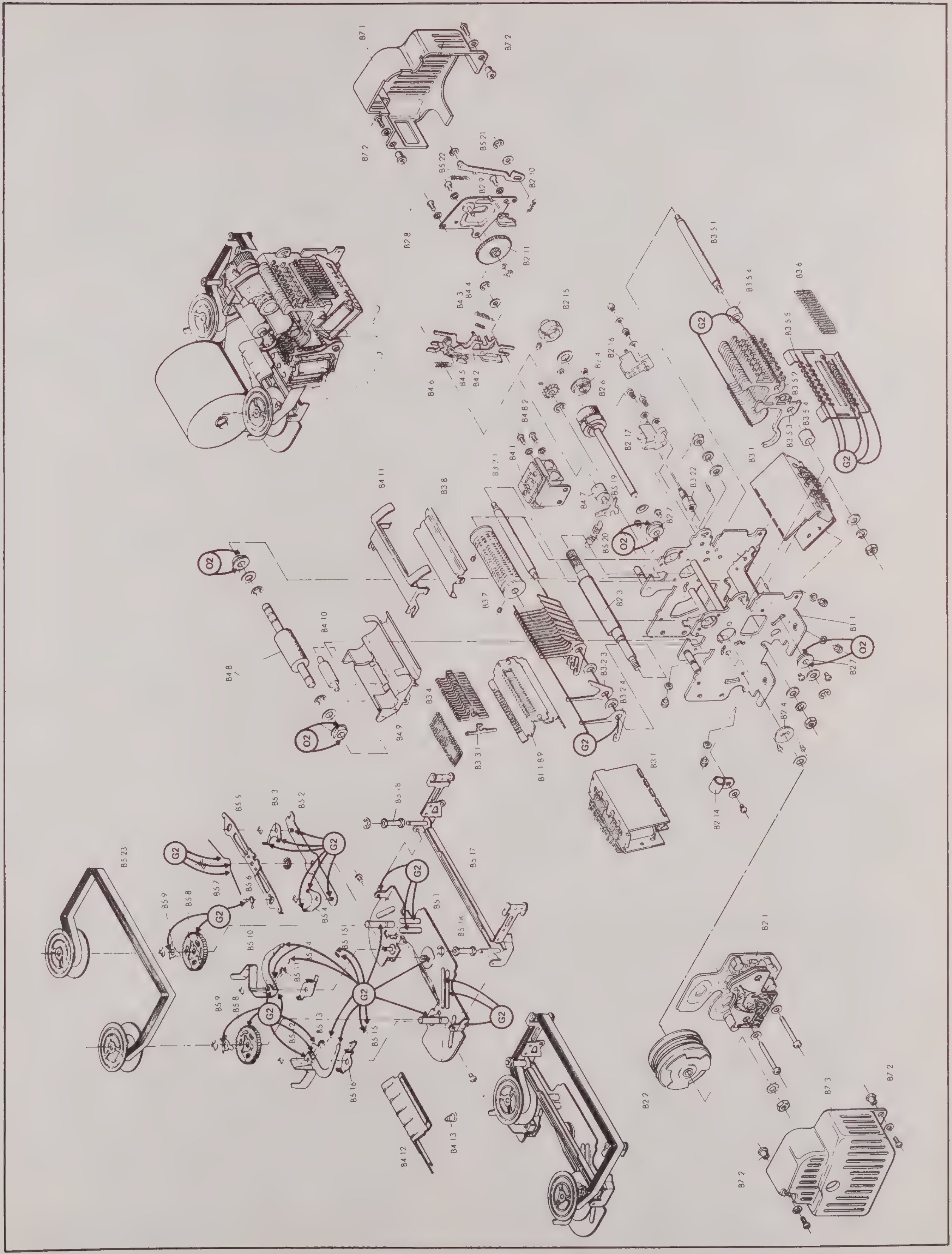

B7 1
B7 2
B7 2
B5 21
B5 22
B2 9
B2 10
B2 8
B2 11
B3 5 1
B4 3
B4 4
B2 15
B2 16
B2 4
B2 6
B4 6
B4 5
B4 2
B4 8 2
B4 1
B3 2 1
B2 17
B4 7
B5 19
B3 22
B2 7
B5 20
B3 5 4
B3 6
B3 5 5
B3 5 2
B3 5 3
B3 5 4
B3 1
G2
O2
B4 11
B3 8
B3 7
B2 3
B1 1
B2 7
O2
O2
B4 10
B4 8
B4 9
O2
B3 4
B3 2 3
B3 2 4
G2
B3 3 1
B1 1 89
B3 1
B2 4
B2 14
B5 5
B5 3
B5 2
B5 23
G2
G2
B5 9
B5 8
B5 7
B5 6
G2
B5 4
B5 18
B5 17
G2
B5 1
B5 10
B5 151
B5 14
B5 11
G2
B5 9
B5 8
G2
B5 13
B5 12
B5 15
G2
B5 16
B4 12
B4 13
B2 1
B2 2
B7 3
B7 2
B7 2

Figure 4-3. Lubrication Chart

NOTE

If it becomes necessary to change the line frequency from that originally specified, a crystal on the guard crossing must be changed. Contact your nearest Fluke Representative or the John Fluke Mfg. Co., Inc.

6. Install the proper fuse in the rear panel fuse holder. See Fuse Replacement procedure in following the paragraphs.

7. Install the top dust cover.

4-37. Fuse Replacement

4-38. The power fuse is located on the rear panel of the data logger. If replacement is necessary, select the fuse rating according to the local line voltage as listed below:

1. 100V ac - 3/4A Slo-Blo
2. 115V ac - 3/4A Slo-Blo
3. 230V ac - 3/8A Slo-Blo

NOTE

The fuse holder cap can be replaced with a metric cap (John Fluke P/N 424440) which will accept 5 mm X 20 mm fuses.

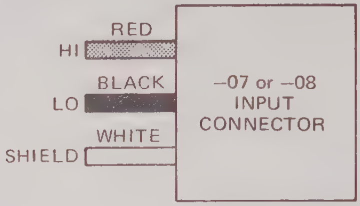
4-39. Service Tools

4-40. A special scanner interface cable is required to execute the Performance Test given later in this section. The cable is fabricated using either of the available input connectors (Option -07 or -08) and a length of 20 gauge insulated wire. The instructions necessary to fabricate the cable are given in Figure 4-4.

4-41. A set of PCB Extender Cables are available for servicing the plug-in pcb contained in the data logger. The extender cables are available as accessories and are described in Section 6, Options and Accessory Information.

4-42. PERFORMANCE TEST

4-43. The performance test is designed to verify the overall operation of the 2200B and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 4-1. The entire test should be executed in the sequence given. If the 2200B fails any part of the performance test, corrective action is indicated. Troubleshooting information is given at the end of this section.



Use the following procedure to prepare the above test cable:

1. Cut a 24-inch length of each of the following wires. Use insulated, 20 gauge, standard wire:
    a. Red
    b. Black
    c. White
2. Refer to the connector decal for pin locations and connect the wires from step 1 to the following connector inputs:
    a. Red wire to HI –0 and HI –5.
    b. Black wire to LO –0 and LO –5.
    c. White wire to SH –0 and SH–5.
3. Strip ½ inch of insulation from the free ends of the red, black and white wires, and tin the exposed wire.
4. Install the following jumpers on the input connector. Use bare copper hook-up wire:
    a . LO–1 to HI–1
    b. LO–2 to HI–2
    c. LO–3 to HI–3
    d. LO–4 to HI–4
    e. LO–6 to HI–6
    f. LO–7 to HI–7
    g. LO–8 to HI–8
    H. LO–9 to HI–9

Figure 4-4. 2200B Test Cable

4-44. Set-Up Procedure

4-45. Prior to executing the performance test complete the following set-up procedure:

1. Install a Low-Level Scanner (Option -06) in slot 0 (Channel 0-9) of the 2200B. The dust cover and the left rear inner cover should be removed for the duration of the performance test.

2. Attach the test cable described earlier under Service Tools to the scanner in slot 0.

3. Select the Block Mode of Operation (i.e., set switch 4 on the Controller PCB to OFF).

4. Connect the free end of the test cable to the output of the DC Voltage Calibrator (Red to +, Black to –, and White to ground).

5. Set the DC Voltage Calibrator for a 0V dc output.

6. Energize the DC Voltage Calibrator.

7. Press the RESET switch in the 2200B's SCAN CONTROL group.

8. Release all switches in the OUTPUT CONTROL group.

9. Connect the 2200B to line power and set the POWER switch to ON. The data display should illuminate and display 2200 1.

4-46. Channel Display Test

4-47. Use the following procedure to check the operation of the channel display:

1. Program blocks 0 through 5 to the 4V range.

2. Set the FIRST CHANNEL switch to 00.

3. Set the LAST CHANNEL switches to 59.

4. Press the SINGLE switch in the SCAN CONTROL group and observe the channel display. The display should start at 00 and sequentially advance to 59. Verify the operation of all channel numbers.

5. Press the RESET switch in the SCAN CONTROL group.

4-48. Data Display Test

4-49. Use the following procedure to test the 2200B data display:

1. Set the MONITOR CHANNEL switches to 00.

2. Press the MONITOR switch in the SCAN CONTROL group. The data display should indicate the output of the DC Voltage Calibrator (0.0000V).

3. Increase the outputs of the DC Voltage Calibrator in 0.1 mV increments. Observe the LSD on the display and verify the operation of each digit.

4. Check the digits in each of the remaining decades by adjusting the output of the DC Voltage Calibrator. The MSD of the display is limited to 3 maximum. All other digits should operate over a range of 0 through 9.

NOTE

When the input voltage exceeds the 39999 full-scale capacity on any range, the display overloads and exhibits a series of u's.

5. Set the DC Voltage Calibrator for a 1.0000V dc output.

6. Press the RESET switch in the SCAN CONTROL group.

4-50. Scan Control Test

4-51. The following procedure is used to check the operation of the 2200B scan control logic and measurement circuitry:

1. Set the LAST CHANNEL switches to 09.

2. Press the PRINTER ALL DATA switch in the OUTPUT CONTROL group.

3. Press the SINGLE switch in the SCAN CONTROL group. The printer should record inputs of 1.0000V dc at channels 0 and 5, and 0V dc at all other channels.

4. Press the RESET switch in the SCAN CONTROL group.

5. Set the LAST CHANNEL switches to 05.

6. Program the time interval to 1 minute.

7. Adjust the DC Voltage Calibrator for a 2.0000V dc output.

8. Press the INTERVAL switch in the SCAN CONTROL group. The printer should record a 2.0000V dc reading for channels 0 and 5. The scan cycle should repeat itself at the programmed interval, 1 minute.

9. Press the MONITOR switch in the SCAN CONTROL group. The display should indicate a 2.0000V dc input to channel 0.

10. Increase the calibrator output to 5.0V dc. The data display should exhibit a series of u's to indicate the presence of an overrange voltage.

11. Press the CONTINUOUS switch in the SCAN CONTROL group. The printer should print: – : - for both channels 0 and 5 to indicate the presence of an overrange voltage. The scan cycle should continue to repeat with a minimum time between the end of one cycle and the start of the next.

12. Press the RESET switch in the SCAN CONTROL group.

4-52. A/D Converter Accuracy Test

4-53. Use the following procedure to check the operation of the A/D Converter.

NOTE

This procedure assumes that the Scan Control Test has been completed and that the conditions existing at the end of that test are still present.

1. Set the calibrator output to 0V dc.

2. Press the MONITOR switch in the SCAN CONTROL switch group.

3. Set the Fast/Slow switch on the A/D Converter PCB to Slow.

4. Refer to Table 4-2 and sequentially enter each of the input voltage and data logger range combinations for channel (monitor channel). As each entry is completed check the data logger display against the indicated display readings.

5. Disconnect the calibrator, and remove the test cable and the scanner from the 2200B.

6. Return the Mode switch on the Controller PCB to its original position (Block mode to OFF, Individual mode to ON).

7. Install the inner cover and the top dust cover.

8. Set 2200B POWER switch to OFF and disconnect line power.

Table 4-2. A/D Converter Accuracy Test Specifications

INPUT VOLTAGE	RANGE (FUNCTION)	(90 DAY SPECIFICATION, 20°C to 30°C AMBIENT) DISPLAY READING WITH LOW LEVEL SCANNER
0.0V	40 mV	–0.005 to 0.005
0.0V	400 mV	–0.02 to 0.02
0.0V	4V	–0.0002 to 0.0002
0.0V	40V	–0.002 to 0.002
39.9 mV	40 mV	39.894 to 39.906
399 mV	400 mV	398.94 to 399.06
3.99V	4V	3.984 to 3.996
39.9V	40V	39.84 to 39.96

4-54. CALIBRATION ADJUSTMENTS

4-55. The 2200B should be calibrated every year/90 days (as required to maintain desired accuracy), or whenever repairs have been made to the Power Supply or the A/D Converter. Calibration should be accomplished at an ambient room temperature of +22 to +25°C, and a relative humidity of less than 70%. Table 4-1 lists the required equipment.

4-56. Initial Procedure

1. Remove the top dust cover from the 2200B.

2. Press the RESET switch in the SCAN CONTROL group.

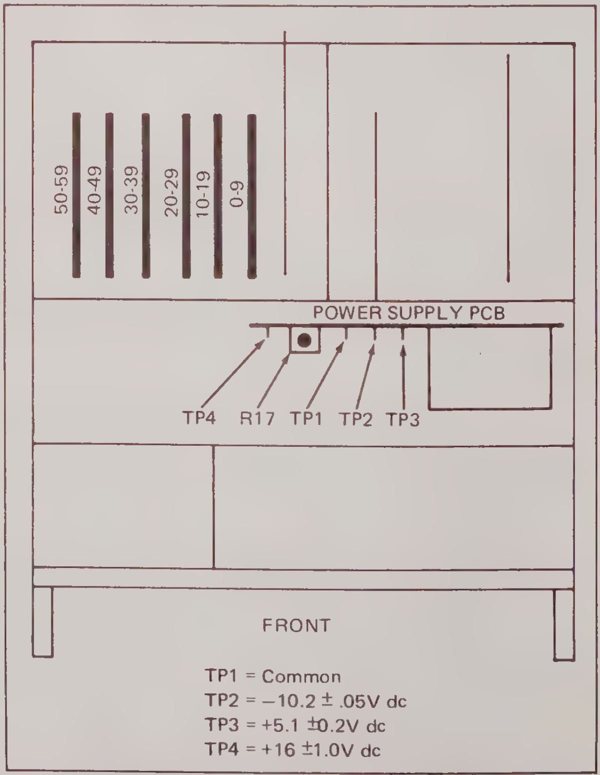
3. Connect the 2200B to line power and set the POWER switch to ON.

4. Allow the 2200B to stabilize for at least 1 hour.

4-57. Power Supply

4-58. Use the following procedure to calibrate the Power Supply PCB.

1. Connect the DVM to TP1 (common) and TP2 (-10V dc) on the Power Supply PCB. See Figure 4-5.



TP1 = Common
TP2 = –10.2 ± .05V dc
TP3 = +5.1 ±0.2V dc
TP4 = +16 ±1.0V dc

Figure 4-5. Power Supply Test Point and Adjustment Locations

2. Adjust pot R17 to obtain a reading of −10.20 ±0.05V dc.

3. Move the DVM input from TP2 to TP3. The DVM should read +5.1 ±0.2V dc.

4. Move the DVM input from TP3 to TP4. The DVM should read +16 ±1.0V dc.

4-59. A/D Converter

4-60. Use the following procedure to calibrate the High Performance A/D Converter PCB Assembly:

CAUTION

Turn power off before removing or installing pcb's.

1. De-energize the data logger and press the STOP/RESET switch in the SCAN CONTROL group.

2. Install a Low Level Scanner (Option -06) in scanner slot 0 of the data logger.

3. Set the output of the DC calibrator to 0V, and, using the test cable, connect the output of the DC calibrator to Channel 0 of the scanner in slot 0.

4. Energize the data logger and program it to perform the following scan sequence:

   a. Monitor Channel 00.

   b. Function = 40 mV.

5. Set the Fast/Slow switch on the A/D Converter to Slow.

6. Press the MONITOR switch and adjust the 40 mV ZERO pot (R7) for a zero indication; i.e., the display alternates between a + and − polarity indication. Ignore the digital display.

NOTE

Under normal conditions steps 7 through 15 may be omitted from the calibration procedure. However, if the A/D Converter has been repaired prior to calibration, component parts have been replaced, or potentiometers R46, R50 or R55 have been inadvertently adjusted, the steps must be executed.

7. Remove the inner guard cover and mount the A/D Converter on extender cables.

8. Connect the DVM between TP4 (common) and TP8. Adjust R54 for a reading of 0 ±20 mV dc.

9. Program the data logger for the 4V function and set the DC Calibrator for a +1 mV output.

10. Adjust R50 for a data logger display of 0.0010V.

11. Reverse the polarity of the DC Calibrator output. The display should read 0.0010V.

12. Set the Fast/Slow switch to Fast and adjust R46 for a display of −0.0010V.

13. Reverse the polarity of the DC Calibrator output. The display should read 0.0010V.

14. Set the Fast/Slow switch to Slow.

15. Set the output of the DC Calibrator to 0V.

16. Connect the DVM between TP4 and TP9.

17. Adjust R72 for a DVM reading of 0 ±5 mV dc.

18. Remove the extender cables, mount the A/D Converter in its slot, and install the inner guard cover. Allow the A/D Converter 30 minutes to stabilize its temperature before proceeding.

19. Set the output of the DC Calibrator to −3.0000 volts and adjust R12 for a display of 3.0000V.

20. Reverse the polarity of the DC Calibrator output. The reading should be −3.0000 ±0.0002V.

21. Set the DC Calibrator output to +300 mV.

22. Program the data logger function to 400 mV and adjust R29 for a display of 300.00 mV.

23. Set the DC Calibrator output to +60 mV.

24. Program the data logger function to 80 mV and adjust R36 for a display of 30000.

NOTE

The 80 mV function is programmed by setting the FUNCTION CODE thumbwheel switch to 9 and pressing the ENTER FUNCTION switch.

25. Set the DC Calibrator output to +30 mV.

26. Program the data logger function to 40 mV and adjust R32 for a reading of +30.000 mV.

27. Program the data logger to the 40V function and set the DC Calibrator output to 0 volts. The display should read 0.000V.

28. Set the DC Calibrator output to +30V and adjust R4 for a display of 30.000V.

29. Connect the DVM between TP1 (common) and TP3 on the A/D Converter PCB. Adjust R21 for a DVM display of +2.0000V dc.

30. Connect a DVM between TP1 and TP2. Adjust R44 for a DVM display of +20.000 mV.

31. Set the DC Calibrator to 0 volts and program the data logger function to 40 mV. The data logger display should read 0.000V.

32. Set the Fast/Slow switch to the speed at which the A/D Converter is to operate and adjust R7 for a data logger display of 0.000V.

4-61. Isothermal Block Connector

4-62. The basic 2200B is capable of housing up to six Isothermal Block Connectors (Option -08) for use in conjunction with the Temperature and Scaling Option. Each Isothermal Block connector has been calibrated at the factory and does not require periodic calibration. However, if a connector has been repaired or if the seal on the factory adjustment has been broken, calibration is required. Refer to subsection -08 in section 6, option and accessory information, for the calibration procedure.

4-63. TROUBLESHOOTING

CAUTION

Static discharge can damage MOS components contained in the 2200B. To prevent this possibility use the following precautions when troubleshooting and/or repairing the unit.

1. Never remove, install or otherwise connect or disconnect pcb's and/or components without first turning the 2200B POWER switch to OFF.

2. Perform all repairs at a static-free work station.

3. Do not handle IC's or pcb's by their connectors.

4. Use static ground straps to discharge repair personnel.

5. Use conductive foam to store replacement or removed IC's.

6. Remove all plastic, vinyl and styrofoam products from the work area.

7. Use a grounded soldering iron.

4-64. A troubleshooting guide for the 2200B is given in Table 4-3. The guide is in the form of a tabular flow chart and is recommended for use in isolating a 2200B mainframe malfunction to the pcb (board) level. Details necessary to troubleshoot faulty pcb's to the component level can be derived from the schematic diagrams given in Section 8 and the Theory of Operation in Section 3.

4-65. When troubleshooting the 2200B in accordance with Table 4-3 the following notes apply:

1. Do not start in the middle of the procedure. Any step assumes that the previous steps have been completed.

2. All measurements using external test equipment are referenced to logic common (TP1 on Power Supply PCB) unless otherwise specified.

3. All connectors referenced for measurement are accessible from the bottom of the 2200B when the bottom dust cover is removed.

Table 4-3. Troubleshooting Guide

STEP NO.	INSTRUCTION	YES	NO	GO TO
1	Set the 2200B POWER switch to OFF and disconnect the power cord at the rear panel.			2
2	Remove the top and bottom dust covers and the inner guard covers from the 2200B.			3
3	Remove all scanner PCB's and input connectors from the scanner section of the 2200B.			4
4	Remove all option PCB's that may be installed in the digital I/O section of the 2200B.			5
5	Remove the A/D Converter PCB and the Guard Crossing PCB from the 2200B.			6
6	Disconnect the printer cable from the Printer Drive PCB.			7
7	Unplug cable connector J7 and J9 on the Mother Board PCB.			8
8	Remove the Controller PCB and set switch #4 to the OFF position (selects block mode of operation).			9
9	Plug the Controller PCB into its assigned slot.			10
10	On the 2200B front panel, depress the RESET switch and release all of the OUTPUT CONTROL swiches.			11
11	Connect the 2200B to line power and set the POWER switch to ON.			12
12	Refer to the Power Supply Calibration procedure given in Section 4 of this manual and verify the presence and accuracy of all power supply voltages.			13
13	Are all power supply voltages correct?	15	14	
14	Isolate and relieve any shorted output condition. Repair and/or calibrate as necessary.			12
15	Set the front panel thumbwheel switches to: S+00000.			16
16	Set the POWER switch to OFF and then ON while observing the front panel display. It should read 2200 1 after turn on.			17
17	Does display respond properly?	19	18	
18	Improper display indications and probable causes.			16

DISPLAY	POSSIBLE CAUSE
Blank	No SYNC pulse at P32-17. POR at P32-18 continuously low. Mode Switch or Display PCB defective.
Two like channel characters lit	One or more Data Bus lines (P32-1, 2, 3, 4) are inoperative.
A twelve (12) appears in the channel display	One or more Control Bus A lines (P32-5, 6, 7, 8) are inoperative. No Strobe Out pulse (P32-16).

Table 4-3. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
19	Turn power off and connect cable connectors P7 and P9 to J7 and J9 on the Mother Board PCB. After the cables are connected set the POWER switch to ON.			20
20	Set the FUNCTION CODE switch to positions 0-9. At each setting, press the SELECT CHANNEL switch and then the ENTER FUNCTION switch. The data display should reflect the range/function represented by the switch setting. See following details:			21

FUNCTION SWITCH SETTING	DATA DISPLAY
0	s s s
1	40.000 Millivolts
2	400.00 Millivolts
3	4.0000 Volts
4	40.000 Volts
5	1 Temperature
6	2 Temperature
7	3 Temperature
8	4 Temperature
9	40000

STEP NO.	INSTRUCTION	YES	NO	GO TO
21	Does display respond properly?	23	22	
22	Improper display indication and probable causes.			16

DISPLAY	POSSIBLE CAUSE
Wrong Range	Defective Basic Programmer
Wrong Digits	Defective Controller
Wrong Function, i.e, V, mV, Temperature	Defective Controller or display

STEP NO.	INSTRUCTION	YES	NO	GO TO
23	Set FUNCTION CODE switch to 3 (4V).			24
24	Sequentially set the CHANNEL or BLOCK NUMBER thumbwheel switch to 0 through 9 and press the SELECT CHANNEL switch followed by the ENTER FUNCTION switch at each setting. Data display will read 4.0000V after the ENTER FUNCTION switch is depressed.			25
25	Set the POWER switch to OFF for 5 minutes and then to ON.			26
26	Review function data in memory for Blocks 0 through 9. It should be the same as previously entered (i.e., 4.0000 Volts). Review is accomplished by sequentially setting the CHANNEL or BLOCK NUMBER switch to 0 through 9 and depressing the SELECT CHANNEL switch at each setting.			27
27	Is recalled function data correct?	29	28	
28	Block Programmer PCB or its battery is defective.			24
29	Set the FIRST CHANNEL thumbwheel switches to 0 and LAST CHANNEL to 99.			30
30	Press CONTINUOUS in the SCAN CONTROL switch group.			31

Table 4-3. Troubleshooting Guide (cont)

<table>
<tr><th>STEP NO.</th><th>INSTRUCTION</th><th>YES</th><th>NO</th><th>GO TO</th></tr>
<tr><td>31</td><td>Momentarily press the PAPER ADVANCE switch in the OUTPUT CONTROL switch group.</td><td></td><td></td><td>32</td></tr>
<tr><td>32</td><td>Does the scan sequence stop?</td><td>34</td><td>33</td><td></td></tr>
<tr><td>33</td><td>Defective Mode Switch PCB.</td><td></td><td></td><td>31</td></tr>
<tr><td>34</td><td>Set POWER switch to OFF and then ON. Scan sequence will resume.</td><td></td><td></td><td>35</td></tr>
<tr><td>35</td><td>Press MONITOR in the SCAN CONTROL switch group and set each decade of the MONITOR CHANNEL thumbwheel switches to each of their 10 possible positions.</td><td></td><td></td><td>36</td></tr>
<tr><td>36</td><td>Does the Channel display change to indicate each new switch position as it is selected?
NOTE
When the ten's thumbwheel is set to 0 (zero) the ten digit on the Channel display is blanked.</td><td>38</td><td>37</td><td></td></tr>
<tr><td>37</td><td>Basic Programmer PCB is defective.</td><td></td><td></td><td>35</td></tr>
<tr><td>38</td><td>Set MONTIOR or LAST CHANNEL switches to 90.</td><td></td><td></td><td>39</td></tr>
<tr><td>39</td><td>Press RESET switch in the SCAN CONTROL group.</td><td>40</td><td></td><td></td></tr>
<tr><td>40</td><td>Set the POWER switch to OFF.</td><td></td><td></td><td>41</td></tr>
<tr><td>41</td><td>Install the Guard Crossing PCB.</td><td></td><td></td><td>42</td></tr>
<tr><td>42</td><td>Set the POWER switch to ON.</td><td></td><td></td><td>43</td></tr>
<tr><td>43</td><td>Set the FUNCTION CODE switch to positions 0-9. At each setting, press the SELECT CHANNEL switch and then the ENTER FUNCTION switch. The data display should reflect the range 1 function represented by the switch setting. See following details:
<table>
<tr><th>FUNCTION SWITCH SETTING</th><th>DATA DISPLAY</th></tr>
<tr><td>0</td><td>s s s</td></tr>
<tr><td>1</td><td>40.000 Millivolts</td></tr>
<tr><td>2</td><td>400.00 Millivolts</td></tr>
<tr><td>3</td><td>4.0000 Volts</td></tr>
<tr><td>4</td><td>40.000 Volts</td></tr>
<tr><td>5</td><td>1 Temperature</td></tr>
<tr><td>6</td><td>2 Temperature</td></tr>
<tr><td>7</td><td>3 Temperature</td></tr>
<tr><td>8</td><td>4 Temperature</td></tr>
<tr><td>9</td><td>40000</td></tr>
</table></td><td></td><td></td><td>44</td></tr>
<tr><td>44</td><td>Is display data correct for each switch setting?</td><td>46</td><td>45</td><td></td></tr>
</table>

Table 4-3. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
45	Guard Crossing PCB is defective.			40
46	Program each block (0-9) to the 4.0000 Volt range.			47
47	Press the CONTINUOUS switch in the SCAN CONTROL switch group. Channel data should sequence from 0 through 90 and data display should read u.uuuu volts.			48
48	Is the display correct and does the scanning sequence appear to be slower with the Guard Crossing PCB installed?	50	49	
49	Defective Guard Crossing PCB.			40
50	Set POWER switch to OFF.			51
51	Install the A/D Converter PCB and short TP4 to TP7 on that pcb.			52
52	Set the POWER switch to ON.			53
53	Press the ONTINUOUS scan switch.			54
54	Does the data display read 0.0000 ±0.0002 volts at channels 0 through 90?	56	55	
55	Defective A/D Converter PCB.			50
56	Remove the short and insert a known voltage (between 1 and 4V dc) between TP4 and TP7 on the A/D Converter PCB.			57
57	Does the data display indicate the level of the input voltage?	58	55	
58	Set POWER switch to OFF.			59
59	Connect the Printer Cable to the Printer Drive PCB.			60
60	Set the POWER switch to ON.			61
61	Does Printer sound like it's running?	63	62	
62	Check for the presence of ±16V dc on the Power Supply PCB. If the voltage is present, either the printer head is defective or the voltage is not reaching the printer head. Repair as required.			58
63	Make sure the CONTINUOUS scan switch is still depressed and then press the PAPER ADVANCE switch.			64
64	Does the printer advance its paper?	66	65	
65	If scan sequence stops, printer head is defective. Interrupting line power with POWER switch will cause scan sequence to resume.			58
66	Press RESET/PROGRAM in the SCAN CONTROL switch group.			67

Table 4-3. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
67	Press PRINTER, ALL DATA switch in the OUTPUT CONTROL group.			68
68	Press SINGLE switch in the SCAN CONTROL group.			69
69	The printer should print the input voltage to the A/D Converter as shown in the following example. Time should be printed first. Then channels 0 through 90 should be printed in sequence.			70

```
 90      2.0000    V
            ↑
           THRU
            ↓
 10      2.0000    V
  9      2.0000    V
  8      2.0000    V
  7      1.9999    V
  6      2.0000    V
  5      2.0000    V
  4      2.0000    V
  3      1.9999    V
  2      2.0000    V
  1      2.0001    V
  0      2.0000    V

   09:10:11
```

NOTE
In the above example the input to the A/D Converter was 2.0V dc.

STEP NO.	INSTRUCTION	YES	NO	GO TO
70	Does the printer respond correctly?	72	71	
71	Defective Printer Drive PCB or printer head. Repair as required.			58
72	Press RESET/PROGRAM.			73
73	Set POWER switch to OFF.			74
74	Remove A/D Converter PCB.			75
75	Set the LAST CHANNEL switches to 09.			76
76	Set POWER switch to ON.			77
77	Press the SINGLE switch in the SCAN CONTROL group.			78

Table 4-3. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
78	The printer should print on overload indication for channels 0 through 9 as shown in the following example:			79

```
9        ;--:-    V
8        ;--:-    V
7        ;--:-    V
6        ;--:-    V
5        ;--:-    V
4        ;--:-    V
3        ;--:-    V
2        ;--:-    V
1        ;--:-    V
0        ;--:-    V

  09:12:29
```

79	Does the printer respond properly?	81	80	
80	If data display indicates u.uuuu volts, either the Printer Drive PCB or the printer is defective. If the display indicates other than u.uuuu volts, the Guard Crossing is defective. Repair as required.			73
81	Press RESET/PROGRAM in the SCAN CONTROL switch group.			82
82	Set the POWER switch to OFF.			83
83	Install the A/D Converter PCB and remove any connections between TP4 and TP7.			84
84	Set the POWER switch to ON.			85
85	Program block 0 to a thermocouple range and set LAST CHANNEL switches to 09.			86
86	Press the SINGLE scan switch.			87
87	The printer should print an open thermocouple indication for channels 0 through 9 as shown in the following example. Data display should read cccc.c TEMPERATURE.			88

```
9        ****,*   ℃
8        ****,*   ℃
7        ****,*   ℃
6        ****,*   ℃
5        ****,*   ℃
4        ****,*   ℃
3        ****,*   ℃
2        ****,*   ℃
1        ****,*   ℃
0        ****,*   ℃

  09:15:08
```

NOTE

Temperature scale may be either °C or °F.

Table 4-3. Troubleshooting Guide (cont)

STEP NO.	INSTRUCTION	YES	NO	GO TO
88	Does the printer and the display respond properly?	90	89	
89	If the display and printer are both in error the Temperature Scaling Circuit on the A/D Converter and/or Controller PCB is defective. If only the print-out is in error the Controller is defective. Repair as required.			82
90	The 2200B is operational.			

Section 5

List of Replaceable Parts

TABLE OF CONTENTS

TITLE	TABLE	PAGE	FIGURE	PAGE
Final Assembly, Model 2200B	5-1	5-3	5-1	5-6
2200B Final Assembly, Chassis	5-2	5-7	5-2	5-9
A1 Mother Board PCB Assembly	5-3	5-12	5-3	5-13
A2 Power Supply PCB Assembly	5-4	5-14	5-4	5-16
A3 Controller PCB Assembly	5-5	5-17	5-5	5-19
A4 Guard Crossing PCB Assembly	5-6	5-20	5-6	5-22
A5 Printer Drive PCB Assembly	5-7	5-22	5-7	5-25
A6 Display PCB Assembly	5-8	5-26	5-8	5-28
A7 Mode Switch PCB Assembly	5-9	5-29	5-9	5-30
A8 Basic Programmer PCB Assembly	5-10	5-31	5-10	5-31
A9 Block Programmer/Memory PCB Assembly	5-11	5-32	5-11	5-33
A10 High Performance A/D Converter PCB Assembly	5-12	5-34	5-12	5-38
A11 Temperature PCB Assembly	5-13	5-39	5-13	5-39

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. A similar parts listing for each of the Options will be found in Section 6. Components are listed alphanumerically by assembly. Both electrical and mechanical components are listed first by reference designation and second by item number. Each listed part is shown in an accompanying illustration.

5-3. Parts lists include the following information:

1. Reference Designation or Item Number.
2. Description of each part.
3. FLUKE Stock Number.
4. Federal Supply Code for Manufacturers. (See Section 7 for Code-to-Name list.)
5. Manufacturer's Part Number or Type.
6. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenenace site. For maintenance for one year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc., that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions if necessary.

5-6. To ensure prompt and efficient handling of your order, include the following information:

1. Quantity.
2. FLUKE Stock Number.
3. Description.
4. Reference Designation or Item Number.
5. Printed Circuit Board Part Number.
6. Instrument Model and Serial Number.

CAUTION

⊘

Indicated devices are subject to damage by static discharge.

Table 5-1. Final Assembly, Model 2200B

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	⊘ FINAL ASSEMBLY MODEL 2200B FIGURE 5-1.	2200B	89536				
	FINAL ASSEMBLY, CHASSIS	ORDER	NEXT	HIGHER ASSY.	1		
A1	MOTHER BOARD PCB ASSEMBLY, TESTED	409425	89536	409425	1		
A2	⊘ POWER SUPPLY PCB ASSEMBLY 115/230VAC	409433	89536	409433	1		
	100VAC	426676	89536	426676			
A3	⊘ CONTROLLER PCB ASSEMBLY, TESTED	451013	89536	451013	1		
A4	⊘ GUARD CROSSING PCB ASSEMBLY, TESTED	409458	89536	409458	1		
A5	⊘ PRINTER DRIVE PCB ASSEMBLY, TESTED	409482	89536	409482	1		
A6	DISPLAY PCB ASSEMBLY, TESTED	409490	89536	409490	1		
A7	⊘ MODE SWITCH PCB ASSEMBLY, TESTED	502252	89536	502252	1		
A8	⊘ BASIC PROGRAMMER PCB ASSEMBLY, TESTED	502260	89536	502260	1		
A9	⊘ BLOCK PROGRAM/ MEMORY ASSEMBLY	502278	89536	502278	1		
A10	⊘ HIGH PERFORMANCE A-D ASSEMBLY	409599	89536	409599	1		
A11	TEMPERATURE PCB ASSEMBLY	409565	89536	409565	1		
06	LOW LEVEL SCANNER (OPTION -06, SEE SECTION 6)				1		
08	ISOTHERMAL BLOCK CONNECTOR (OPTION -08, SEE SECTION 6)				1		
F1	FUSE, SLOW-BLOW, 3/4 AMP	109256	89536	109256	1	5	
	3/8A (USE WITH 230V/150 HZ)	109264	89536	109264			
H1	NUT, HEX, 10-32	110536	89536	110536	2		
H2	SCREW, PHP SEMS, 4-40 X 1/4	185918	89536	185918	4		
H3	SCREW, PP, S/STEEL, 4-40 X 7/8	335133	89536	335133	2		
H4	SCREW, FHP U/C, 6-32 X 1/4	320093	89536	320093	12		
H5	SCREW, PHP, S/STEEL, 6-32 X 1/4	385401	89536	385401	4		
H6	SCREW, PHP, 6-32 X 1/4	152140	89536	152140	8		
H7	SCREW, PHP, 6-32 X 1/2	152173	89536	152173	6		
H8	SCREW, PHP W/LOCK, 6-32 X 1/2	177030	89536	177030	4		
H9	SCREW, PHP, S/STEEL, 6-32 X 3/8	334458	89536	334458	16		
H10	SCREW, FHP, S/STEEL, 6-32 X 3/8	306183	89536	306183	1		
H11	SCREW, PHP, 6-32 X 5/16	152157	89536	152157	10		
H12	SCREW, 6-32 X 1-1/4	169756	89536	169756	4		
H13	SCREW, RHP, 6-32 X 1-1/2	114181	89536	114181	6		
H14	SCREW, RHP, 8-32 X 3/8	114124	89536	114124	4		
H15	SCREW, RHP, 10-32 X 1/2	114447	89536	114447	1		
H16	WASHER, FLAT	260471	89536	260471	20		
H17	WASHER, FLAT #4, S/STEEL	146225	89536	146225	2		
H18	WASHER, FLAT, BRASS #6	111054	89536	111054	26		
H19	WASHER, INT/LOCK #6	110338	89536	110338	4		
H20	WASHER, SPLIT/LK, #10 (NOT SHOWN)	111484	89536	111484	1		
H21	WASHER, SPLIT/LK, #6	110692	89536	110692	24		
H22	WASHER, SPLIT/LK, S/STEEL, #6	403923	89536	403923	20		
H23	WASHER, INT/LOCK, #8	110320	89536	110320	4		
H24	WASHER, INT/LOCK, #10	110312	89536	110312	1		
MP1	BRACKET, DISPLAY	411702	89536	411702	1		
MP2	BRACKET, PROGRAMMER PCB	502195	89536	502195	1		
MP3	COVER, BOTTOM	412288	89536	412288	1		
MP4	COVER, GUARD CHAMBER	411645	89536	411645	1		

Table 5-1. Final Assembly, Model 2200B (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
MP5	COVER, REAR	409623	89536	409623	1		
MP6	COVER, TOP	412270	89536	412270	1		
MP7	BULKHEAD, UNGUARDED	411686	89536	411678	1		
MP8	DECAL, NAMEPLATE	504290	89536	504290	1		
MP9	DECAL, LINE VOLTAGE	473702	89536	473702	1		
MP10	DECAL, CAUTION	453571	89536	453571	1		
MP11	DECAL, CORNER	394403	89536	394403	4		
MP12	DECAL, REAR PANEL	454447	89536	354447	1		
MP13	DECAL, CAUTION	428201	89536	428201	1		
MP14	DECAL, INPUT/OUTPUT IDENTIFICATION	459313	89536	459313	1		
MP15	DECAL, ISOTHERMAL	423517	89536	423517	1		
MP16	FOOT, BAIL STAND	292870	89536	292870	4		
MP17	GROMMET, RUBBER	135269	89536	135269	1		
MP18	CONN, HOUSING, ISOTHERMAL	414276	89536	414276	2		
MP20	TYPEWRITER RIBBON	364117	89536	364117	1		
MP21	STAND, BAIL	231407	89536	231407	1		
MP22	PAPER TAPE (LOCATED IN PRINTER PAPER DRAWER)	362962	89536	362962	1		
U3	⊘ IC, C-MOS, CONTROL PROGRAM MEMORY SET (INCLUDES U3 AND U4) [1]	510305	89536	510305	1	1	
U4	⊘ IC, C-MOS, SEE U3						
U5	⊘ IC, MOS, LINEARIZATION PROGRAM [1] MEMORY SET (INCLUDES U5, U11, & U12)	510313	89536	510313	1	1	
U11	⊘ IC, MOS, SEE U5						
U12	⊘ IC, MOS, SEE U5						
W1	CABLE ASSEMBLY	413344	32038	5132-010	3		
W2	CABLE ASSEMBLY	413344	32038	5132-010	REF		
W3	CABLE ASSEMBLY	413344	32038	5132-010	REF		
W4	CABLE ASSEMBLY	380568	32038	5112-003.25	1		
W5	LINE CORD	343723	89536	343723	1		
Y1	CRYSTAL QUARTZ				1		
	2.4 MHZ (USE WITH 60 HZ LINE)	408153	89536	408153			
	2.0 MHZ (USE WITH 50 HZ LINE)	408161	89536	408161			
	INSTRUCTION MANUAL (NOT SHOWN)	502682	89536	502682			

[1] These components comprise a Custom Program IC Set and must be replaced as a Set. To order the Set, specify the six (6) digit Part Number listed above, the Data Logger Serial Number and the Control Number marked on the IC Set.

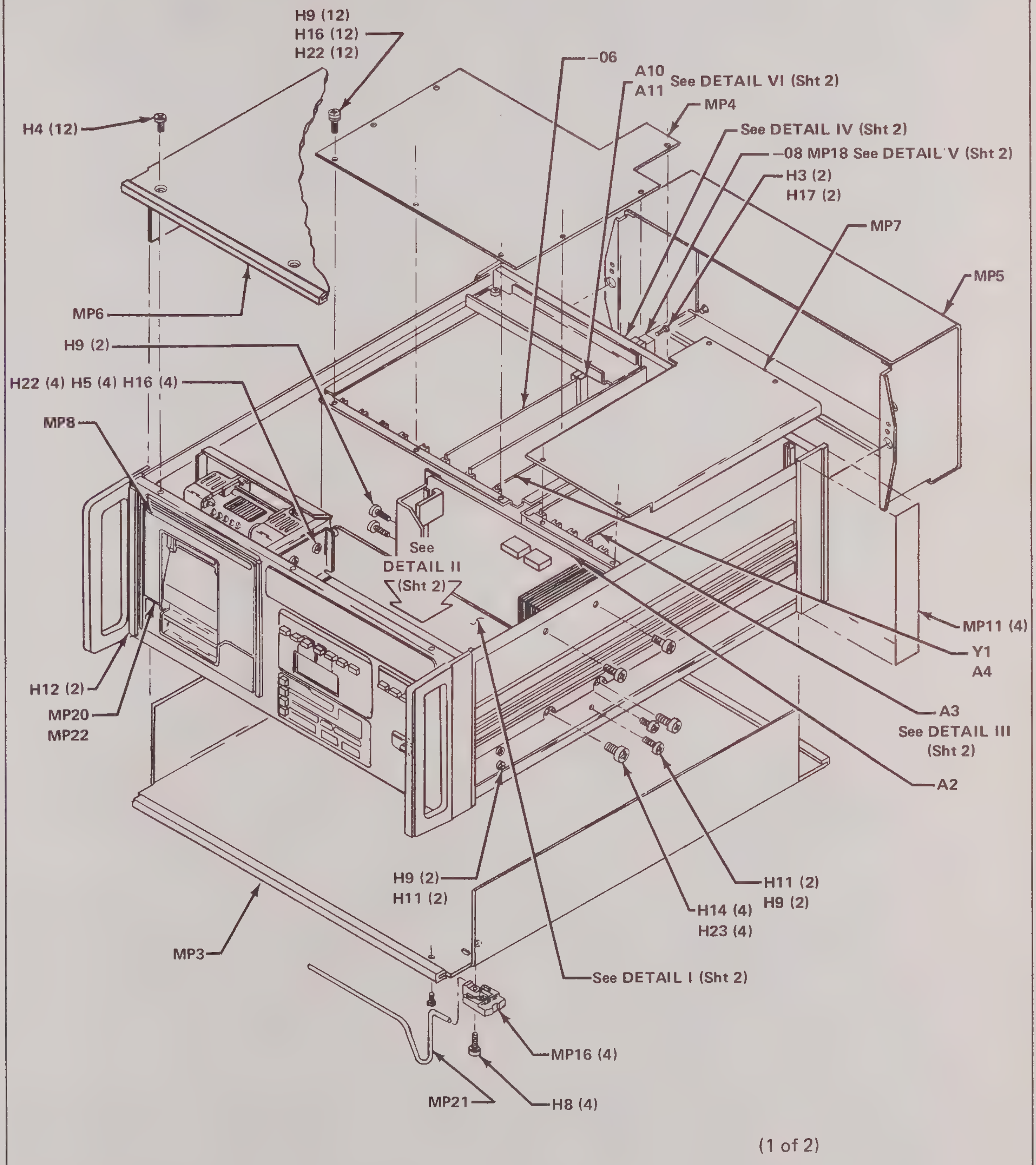

H9 (12)
H16 (12)
H22 (12)
H4 (12)
–06
A10
A11
See DETAIL VI (Sht 2)
MP4
See DETAIL IV (Sht 2)
–08 MP18 See DETAIL V (Sht 2)
H3 (2)
H17 (2)
MP7
MP5
MP6
H9 (2)
H22 (4) H5 (4) H16 (4)
MP8
See
DETAIL II
(Sht 2)
MP11 (4)
Y1
A4
A3
See DETAIL III
(Sht 2)
A2
H12 (2)
MP20
MP22
H9 (2)
H11 (2)
H11 (2)
H9 (2)
H14 (4)
H23 (4)
MP3
See DETAIL I (Sht 2)
MP16 (4)
MP21
H8 (4)
(1 of 2)

Figure 5-1. Final Assembly, Model 2200B

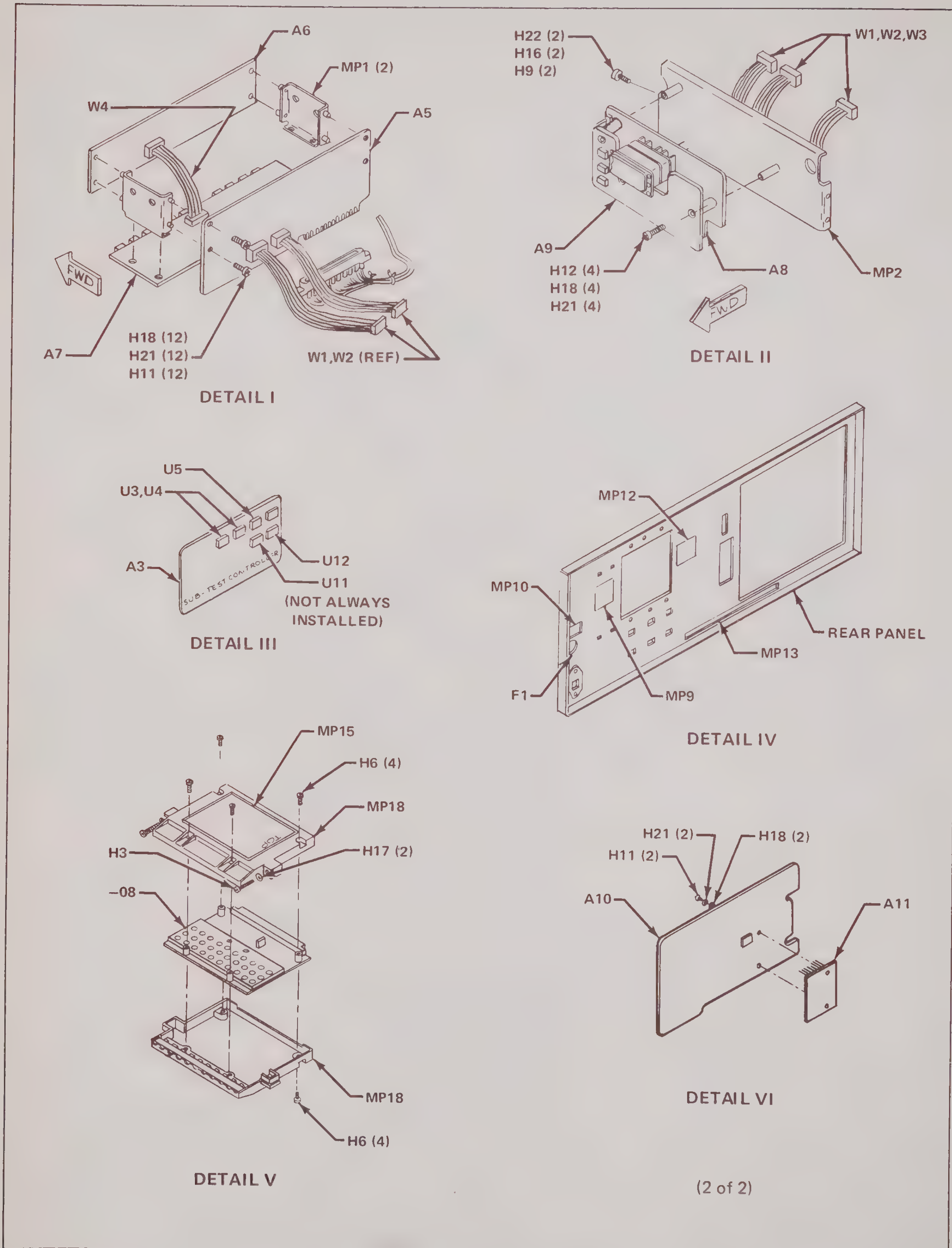

A6
MP1 (2)
W4
A5
A7
H18 (12)
H21 (12)
H11 (12)
W1,W2 (REF)
FWD
DETAIL I
H22 (2)
H16 (2)
H9 (2)
W1,W2,W3
A9
H12 (4)
H18 (4)
H21 (4)
A8
MP2
FWD
DETAIL II
U5
U3,U4
A3
SUB-TEST CONTROLLER
U12
U11
(NOT ALWAYS INSTALLED)
DETAIL III
MP12
MP10
F1
MP9
MP13
REAR PANEL
DETAIL IV
MP15
H6 (4)
MP18
H3
H17 (2)
–08
TOP
MP18
H6 (4)
DETAIL V
H21 (2)
H18 (2)
H11 (2)
A10
A11
DETAIL VI
(2 of 2)

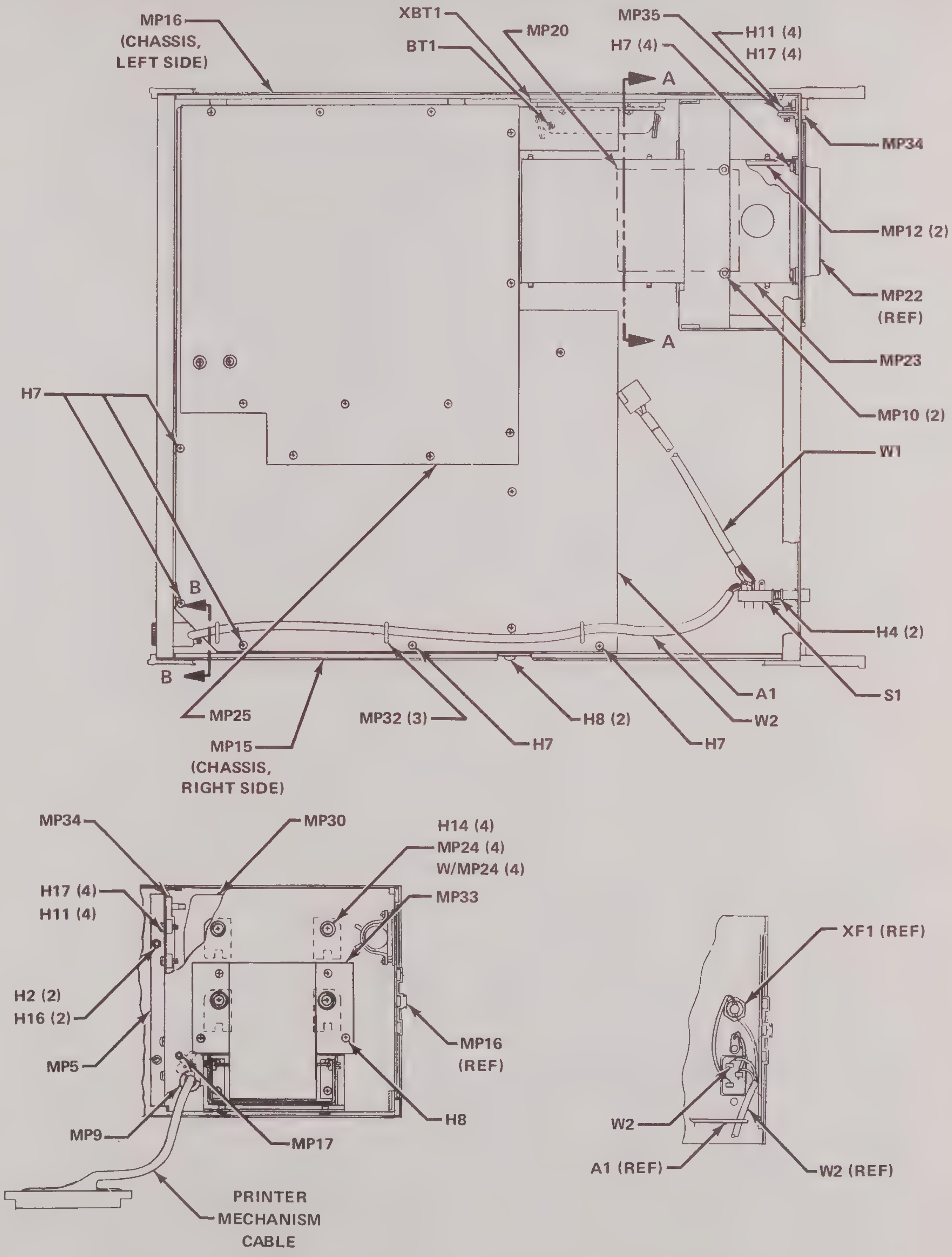
Figure 5-1. Final Assembly, Model 2200B (cont)

Table 5-2. 2200B Final Assembly, Chassis

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, CHASSIS FIGURE 5-2	ORDER	NEXT	HIGHER ASSY.	REF		
BT1	BATTERY ASSEMBLY	462887	89536	462887	1		
H1	NUT, LOCK, 4-40	195255	89536	195255	4		
H2	NUT, 6-32	110551	89536	110551	2		
H3	SCREW, PHP, SEMS, 4-40 X 1/4	185918	89536	185918	9		
H4	SCREW, SEMS, 4-40 X 3/8	281196	89536	281196	2		
H5	SCREW, PHP, 4-40 X 3/8	152124	89536	152124	4		
H6	SCREW, FH, 6-32 X 1/4	320093	89536	320093	2		
H7	SCREW, PHP, W/LK, 6-32 X 1/4	178533	89536	178533	20		
H8	SCREW, PHP, W/LK, 6-32 X 3/8	177022	89536	177022	9		
H9	SCREW, PHP, SEMS, 6-32 X 5/8	272591	89536	272591	11		
H10	SCREW, CAP, 8-32	295105	89536	295105	4		
H11	SCREW, RHP, 8-32 X 3/8	114124	89536	114124	8		
H12	SCREW, FHP, 8-32 X 3/8	114116	89536	114116	12		
H13	SCREW, FHP, 8-32 X 1/2	114355	89536	114355	6		
H14	SCREW, 8MM HD. DIA., 10 MM THREAD	370080	89536	370080	4		
H15	WASHER, FLAT #4	110775	89536	110775	4		
H16	WASHER, LOCK #6	110692	89536	110692	2		
H17	WASHER, LOCK #8	110320	89536	110320	8		
MP1	PRINTER ACCESS DOOR	502641	89536	502641	1		
MP2	BAR, PRINTER CUTTER (LOCATED ON PRINTER HEAD)	423954	54124	1425120	1		
MP5	BRACKET, PRINTER	412254	89536	412254	1		
MP6	BRACKET, ISOTHERMAL	411728	89536	411728	1		
MP7	GUARD, BRACKET	411736	89536	411736	1		
MP8	BULKHEAD, UNGUARDED	411678	89536	411678	1		
MP9	BUSHING, NYLON (FOR PRINTER MECHANISM CABLE)	104620	28520	SB500-6	1		
MP10	BUSHING, NYLON (LOCATED ON BOTTOM OF PRINTER PAPER DRAWER)	102988	28520	SB250-2	2		
MP11	GUIDE PWR SUPPLY	411652	89536	411652	1		
MP12	CARD GUIDE (PRINTER-PAPER DRAWER SLIDES)	229047	23880	1800F	2		
MP13	CARD GUIDE	256461	23880	1450F	17		
MP14	CARD GUIDE (SHORT GUIDES LOCATED ON MOTHER BOARD)	298836	89536	298836	21		
MP15	CHASSIS, RIGHT SIDE	412247	89536	412247	1		
MP16	CHASSIS, LEFT SIDE	412239	89536	412239	1		
MP17	CLAMP, PRINTER CABLE	165951	31827	3-4-1	1		
MP18	CORNER, MACHINED	471375	89536	471375	2		
MP19	DECAL, FRONT PANEL	504357	89536	504357	1		
MP20	DECAL, PAPER LOADING (INSIDE PAPER TAPE DRAWER)	424119	89536	424119	1		
MP21	DECAL, SIDE TRIM	295402	89536	295402	2		
MP22	DRAWER, FRONT	502658	89536	502658	1		
MP23	DRAWER, MAIN	456202	89536	456202	1		
MP24	GROMMET, PRINTER, RUBBER	135269	83330	2172	4		
	BUSHING, STEEL	375162	73734	32-201	4		

Table 5-2. 2200B Final Assembly, Chassis (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
MP25	GUARD, PLANE (LOCATED ON BOTTOM OF MOTHER BOARD)	411637	89536	411637	1		
MP26	GUARD, CHAMBER	411611	89536	411611	1		
MP27	HANDLE, SIDE	394320	89536	394320	2		
MP28	INSULATOR	372342	89536	372342	15		
MP29	DISPLAY LENS	504415	89536	504415	1		
MP30	PRINTER MECHANISM	355446	54124	102	1		
MP31	SPACER, INSULATED	372334	89536	372334	15		
MP32	STAMP, RUBBER	104794	89536	104794	3		
MP33	PAPER TRAY ASSEMBLY	414904	89536	414904	1		
MP34	TRIM, PANEL	502633	89536	502633	2		
MP35	BRACKET, TRIM SUPPORT	411694	89536	411694	1		
S1	SWITCH, POWER (PUSH/PUSH)	291526	89536	291526	1		
	PUSHBUTTON, POWER SWITCH, GREEN	419747	89536	419747	1		
W1	POWER SWITCH CABLE (CONNECTS TO POWER SUPPLY)	374009	89536	374009	1		
W2	POWER SWITCH CABLE (CONNECTS TO POWER CABLE)	373993	89536	373993	1		
XBT1	BASE, BATTERY	462895	89536	462895	1		
XF1	FUSE HOLDER, CAP AND BODY	424416	89536	424416	1		

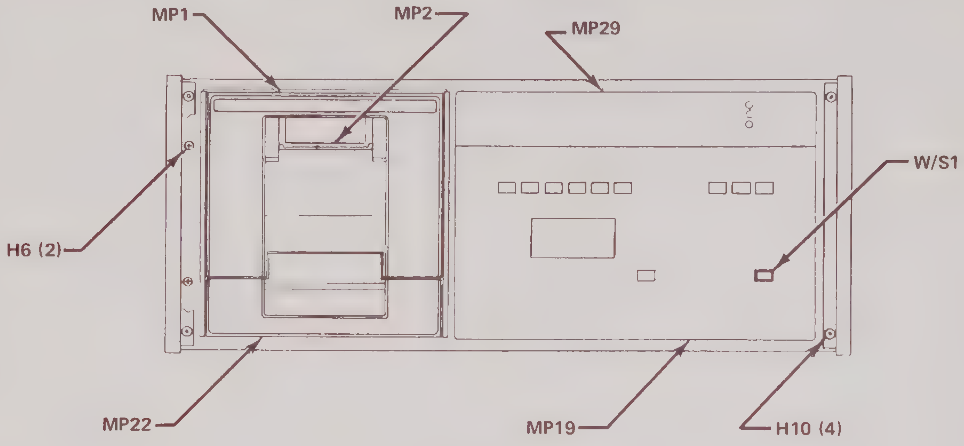

MP16 (CHASSIS, LEFT SIDE)
XBT1
BT1
MP20
MP35
H7 (4)
H11 (4)
H17 (4)
A
MP34
MP12 (2)
MP22 (REF)
MP23
MP10 (2)
W1
H7
B
H4 (2)
S1
A1
W2
H7
H8 (2)
H7
MP32 (3)
MP25
MP15 (CHASSIS, RIGHT SIDE)
MP34
MP30
H14 (4)
MP24 (4)
W/MP24 (4)
MP33
H17 (4)
H11 (4)
H2 (2)
H16 (2)
MP5
MP16 (REF)
H8
MP9
MP17
PRINTER MECHANISM CABLE
XF1 (REF)
W2
A1 (REF)
W2 (REF)

VIEW A–A
(ROTATED 90° CLOCKWISE)

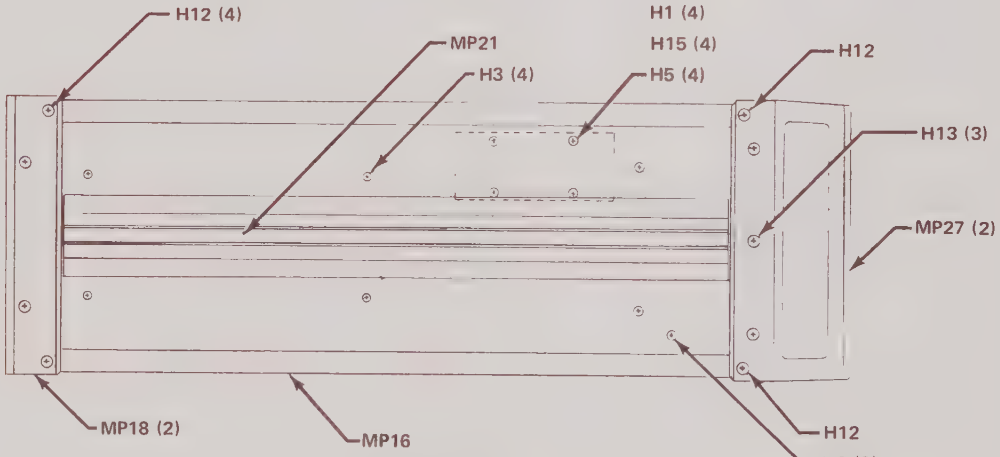
VIEW B–B
(ROTATED 90° COUNTERCLOCKWISE)

(1 of 3)

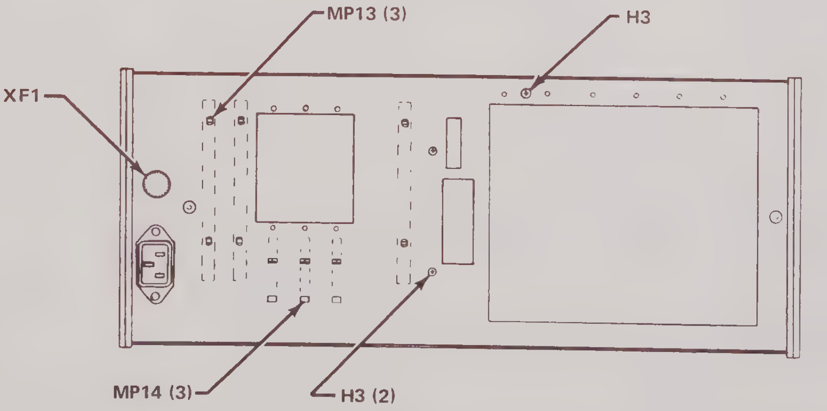
Figure 5-2. 2200B Final Assembly, Chassis


MP1
MP2
MP29
W/S1
H6 (2)
MP22
MP19
H10 (4)

FRONT PANEL


H12 (4)
H1 (4)
MP21
H15 (4)
H12
H3 (4)
H5 (4)
H13 (3)
MP27 (2)
MP18 (2)
MP16
H12
H8 (3)

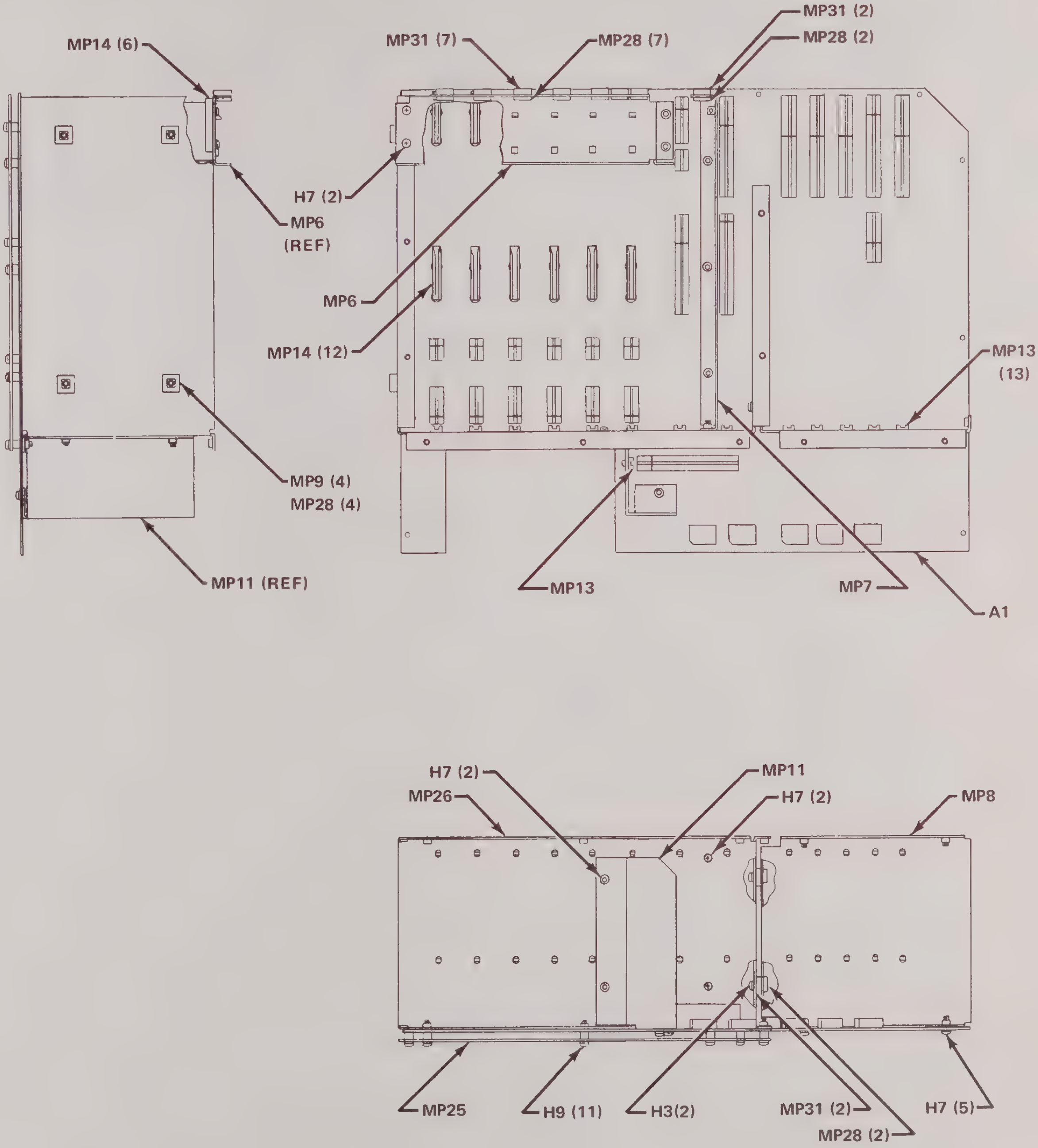
SIDE PANEL


MP13 (3)
H3
XF1
MP14 (3)
H3 (2)

REAR PANEL

(2 of 3)

Figure 5-2. 2200B Final Assembly, Chassis (cont)


MP14 (6)
MP31 (7)
MP28 (7)
MP31 (2)
MP28 (2)
H7 (2)
MP6
(REF)
MP6
MP14 (12)
MP13
(13)
MP9 (4)
MP28 (4)
MP11 (REF)
MP13
MP7
A1
H7 (2)
MP26
MP11
H7 (2)
MP8
MP25
H9 (11)
H3(2)
MP31 (2)
MP28 (2)
H7 (5)

(3 of 3)

Figure 5-2. 2200B Final Assembly, Chassis (cont)

Table 5-3. A1 Mother Board PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A1	MOTHER BOARD PCB ASSEMBLY FIGURE 5-3 (2200A-4001T)	409425	89536	409425	REF		
C1	CAP, CER, 20,000 PF +/-20%	407403	72982	811-000-Z5U0203M	3		
C3	CAP, CER, 20,000 PF +/-20%	407403	72982	811-000-Z5U0203M	REF		
C4	CAP, CER, 20,000 PF +/-20%	407403	72982	811-000-Z5U0203M	REF		
J1	SOCKET, 14-PIN, DIP	387316	71785	133-59-02-059	5		
J3	SOCKET, 14-PIN, DIP	387316	71785	133-59-02-059	REF		
J5	SOCKET, 14-PIN, DIP	387316	71785	133-59-02-059	REF		
J7	SOCKET, 14-PIN, DIP	387316	71785	133-59-02-059	REF		
J9	SOCKET, 14-PIN, DIP	387316	71785	133-59-02-059	REF		
J11	CONNECTOR, 12-PIN	291898	00779	583650-2	6		
J12	CONNECTOR, 6-PIN	291625	00779	583650-1	7		
J23	CONNECTOR, 36-PIN	404947	00779	1-583407-8	6		
J24	CONNECTOR, 6-PIN	291625	00779	583650-1	REF		
J25	CONNECTOR, 16-PIN	404484	00779	583407-9	2		
J26	CONNECTOR, 36-PIN	404947	00779	1-583407-8	REF		
J27	CONNECTOR, 36-PIN	404947	00779	1-583407-8	REF		
J28	CONNECTOR, 36-PIN	404947	00779	1-583407-8	REF		
J31	CONNECTOR, 16-PIN	404484	00779	583407-9	REF		
J32	CONNECTOR, 36-PIN	404947	00779	1-583407-8	REF		
J34	CONNECTOR, 36-PIN	404947	00779	1-583407-8	REF		
MP1	KEY, CONNECTOR, POLORIZING	424572	00779	530286-2	23		

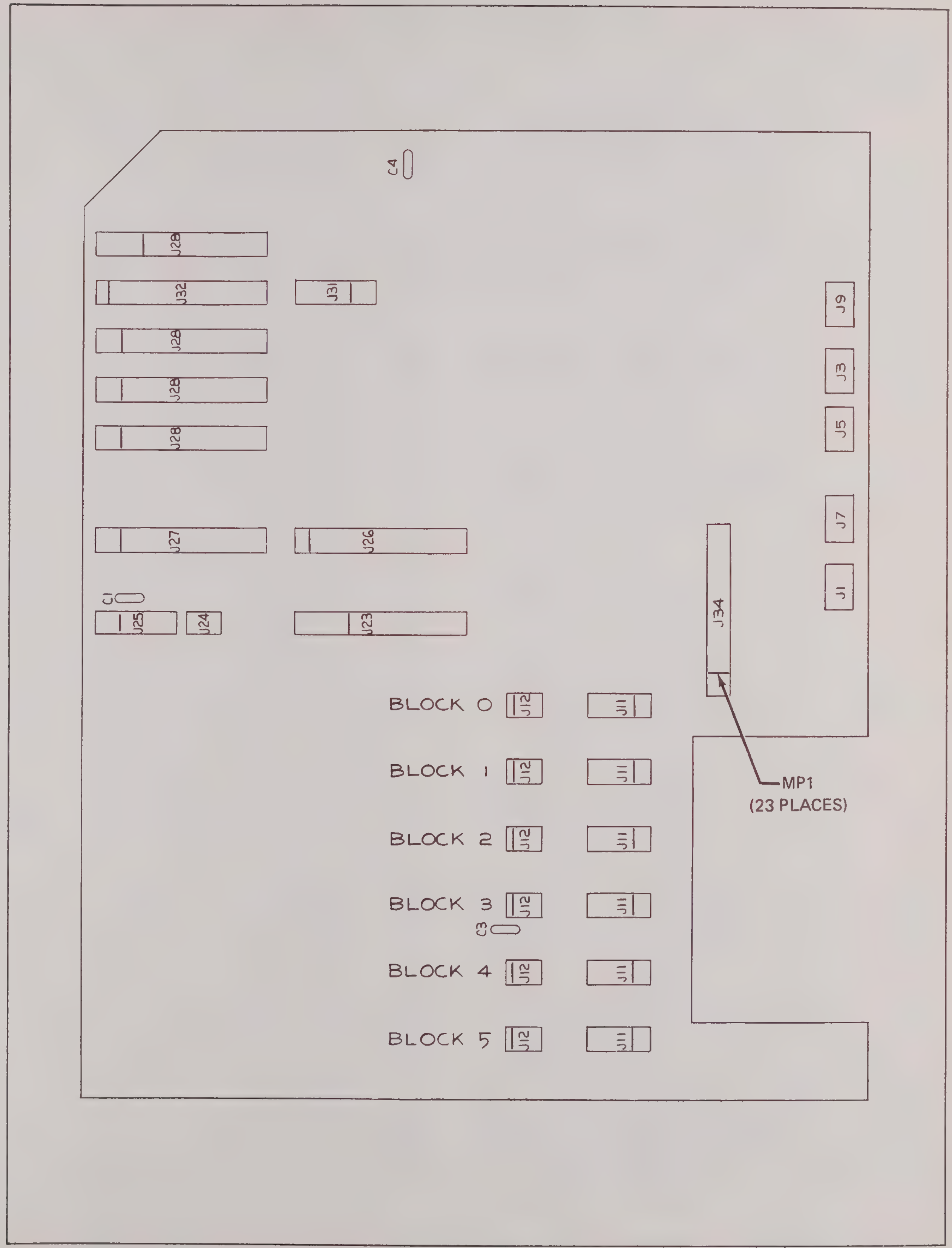

C4
J28
J32
J31
J28
J28
J28
J27
J26
C1
J25
J24
J23
J9
J3
J5
J7
J1
J34
BLOCK 0
J12
J11
BLOCK 1
J12
J11
BLOCK 2
J12
J11
BLOCK 3
J12
J11
C3
BLOCK 4
J12
J11
BLOCK 5
J12
J11
MP1
(23 PLACES)

Figure 5-3. A1 Mother Board PCB Assembly

Table 5-4. A2 Power Supply PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	⊘ POWER SUPPLY PCB ASSEMBLY				REF		
	(115/230V AC) (2200A-4002T)	409433	89536	409433			
	(100V AC) (2200A-4018T)	426676	89536	426676			
	FIGURE 5-4						
C1	CAP, ELECT, 100 UF -10/+50%, 40V	236919	73445	ET101X040A6	2	1	
C2	CAP, ELECT, 100 UF -10/+50%, 40V	236919	73445	ET101X040A6	REF		
C3	CAP, ELECT, 8000 UF -10/+100%, 15V	309245	12676	61C15AS83	1	1	
C4	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	4		
C5	CAP, ELECT, 15,000 UF -10/+75%, 15V	310367	06001	86F520	1	1	
C6	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C7	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	1		
C8	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	3		
C9	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C10	CAP, ELECT, 8000 UF -10/+100%, 25V	309971	80031	39C025SL83	1	1	
C11	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C12	CAP, TA, 4.7 UF +/-20%, 25V	161943	56289	196D475X0025KA1	1		
C13	CAP, CER, 2000 PF GMV, 1 KV	105569	71590	DA140-139CB	1		
C14	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C15	CAP, ELECT, 2100 UF -10/+100%, 35V	370742	80031	33C35JJ212	1	1	
C16	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
CR1	DIODE BRIDGE	296509	09423	FB200	3	1	
CR2	DIODE BRIDGE	296509	09423	FB200	REF		
CR3	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	4	1	
CR4	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	REF		
CR5	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	REF		
CR6	DIODE, SI, HIGH VOLTAGE	325746	04713	MR751	REF		
CR10	DIODE BRIDGE	296509	09423	FB200	REF		
CR11	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	5	1	
CR12	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR14	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR15	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR16	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
H1	WASHER, FLAT #4 (NOT SHOWN)	110775	73734	97201	1		
H2	SCREW, PHP, 4-40 X 3/8	152124	73734	19024	4		
H3	WASHER, LOCK, SPLIT #4 (NOT SHOWN)	110395	73734	1355	1		
H4	NUT, HEX, 4-40 NC2B (NOT SHOWN)	110635	73734	8003	2		
H5	SCREW, PHP, 10-32 X 1/4	218941	73734	19082	2		
H6	LUG, SOLDER	101030	79963	174	2		
H7	SCREW, PHP, 6-32 X 1/2 (NOT SHOWN)	152173	73734	19046	2		
H8	WASHER, LOCK, SPLIT #6	110692	73734	1358	2		
H9	NUT, HEX, 6-32 NC2B	110551	73734	8006	2		
H10	WASHER, LOCK, INTERNAL TOOTH	110312	73734	1306	2		
J48	CONNECTOR, 3-PIN	417154	27264	03-09-2032	1		
	PIN, CONNECTOR	342998	27264	02-09-2133	3		
MP1	HEATSINK	411710	89536	411710	1		
MP2	HEATSINK, SEMICONDUCTOR	386235	13103	6032D	2		
MP3	HEATSINK BRACKET	374934	89536	374934	1		
MP4	DECAL, NAMEPLATE (NOT SHOWN)	433862	89536	433862	1		
MP5	INSULATOR, MICA, XSTR MOUNTING	101493	08530	757	1		
MP6	WASHER, INSULATING	195354	89536	195354	2		

Table 5-4. A2 Power Supply PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
MP7	STRAP, MOUSETAIL	104794	98159	2829-115-3	4		
MP8	XSTR, MTG INSULATOR (NOT SHOWN)	331116	13103	4778A	1		
MP9	WASHER, SHOULDER (NOT SHOWN)	436386	86928	5607-45	1		
Q1	XSTR, SI, NPN	418095	95303	2N6383	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	4	1	
Q3	XSTR, SI, NPN	386128	01295	T1P120	1	1	
Q4	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q5	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	3	1	
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q8	XSTR, SI, NPN	325720	04713	MJE3055	1	1	
Q9	XSTR, FET, N-CHAN	261578	07910	U2366E	1	1	
Q10	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q11	XSTR, SI, PNP	195974	04713	2N3906	REF		
R1	RES, COMP, 2K +/-5%, 1/4W	202879	01121	CB2025	1		
R2	RES, MF, 953 +/-1%, 1/8W	288555	91637	MFF1-89530F	1		
R3	RES, MF, 2.37K +/-1%, 1/8W	293720	91637	MFF1-82371F	1		
R4	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	2		
R5	RES, COMP, 1K +/-5%, 1/4W	148023	01121	DB1025	2		
R6	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	REF		
R7	RES, COMP, 510 +/-5%, 1/4W	218032	01121	CB5115	1		
R9	RES, WW, 0.62 +/-5%, 2W	219352	75042	BWHR62J	1	1	
R10	RES, COMP, 2.7K +/-5%, 1/4W	170720	01121	CB2725	1		
R11	RES, MF, 7.50K +/-1%, 1/8W	223529	91637	MFF1-87501F	1		
R12	RES, COMP, 15K +/-5%, 1/4W	148114	01121	CB1535	1		
R13	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	3		
R14	RES, MF, 1.15K +/-1%, 1/8W	293597	91637	MFF1-81151F	1		
R15	RES, COMP, 2.4K +/-5%, 1/4W	193443	01121	CB2425	1		
R16	RES, COMP, 100 +/-10%, 1/4W	193185	01121	CB1011	1		
R17	RES, VAR, 50 +/-10%, 1/2W	291120	89536	291120	1	1	
R18	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	2		
R19	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	2		
R20	RES, WW, 1.2 +/-5%, 2W	248658	75042	BWH1R2J	2	1	
R21	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	1		
R22	RES, WW, 1.2 +/-5%, 2W	248658	75042	BWH1R2J	REF		
R23	RES, COMP, 1K +/-5%, 1/4W	148023	01121	DB1025	REF		
R24	RES, MF, 5.11K +/-1%, 1/8W	294868	91637	MFF1-85111F	REF		
R25	RES, COMP, 22M +/-10%, 2W	108233	01121	EB2261	1		
R26	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	REF		
R27	RES, MF, 10K +/-1%, 1/8W	168260	91637	MFF1-81002F	REF		
R28	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
S1	SWITCH, SLIDE, DPDT	234278	82389	XW1649	1	1	
S2	SWITCH, SLIDE SPDT	386813	89536	386813	1	1	
T1	TRANSFORMER, POWER				1		
	115/230V	409979	89536	409979			
	100V	427765	89536	427765			
U1	⊘ IC, C-MOS, HEX BUFFER	381830	04713	MC14050CP	1	1	
U2	IC, LIN, OP AMP	310219	12040	LM304H	1	1	
U3	⊘ IC, C-MOS, TIME BASE GENERATOR	404251	04713	MC14566CP	1	1	
VR1	IC, LIN, VOL, REGULATOR	355107	07263	F7805UC	1	1	
VR2	DIODE, ZENER	277236	07910	1N752A	1	1	
XU3	SOCKET, IC, 16-PIN	276535	91506	316AG39D	1	1	

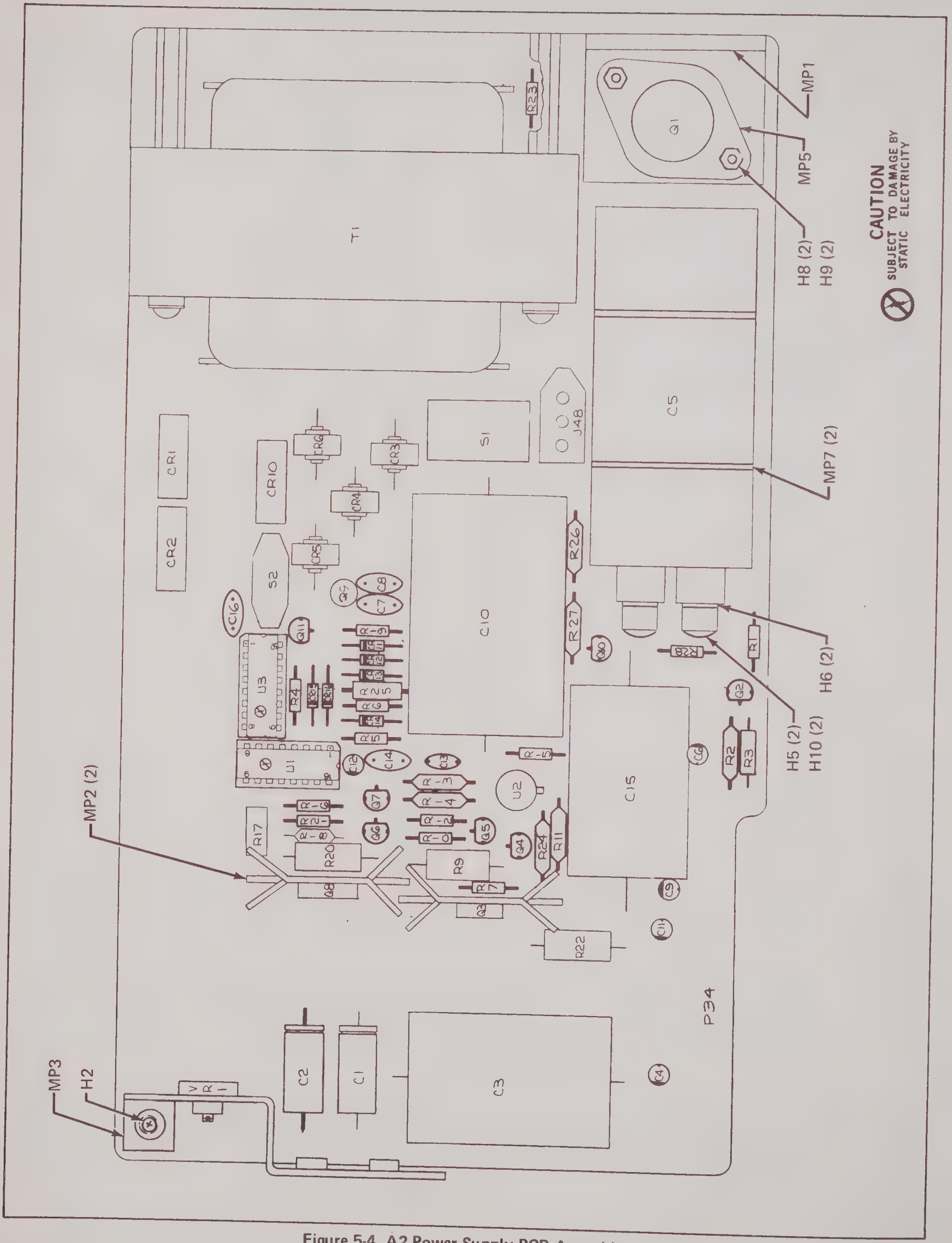

MP1
MP5
H8 (2)
H9 (2)
CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY
MP7 (2)
H6 (2)
H5 (2)
H10 (2)
MP2 (2)
MP3
H2
P34
T1
Q1
R23
C5
J48
S1
CR1
CR2
CR10
CR6
CR3
CR4
CR5
S2
C16
Q9
C8
C7
C10
R26
R27
Q10
R28
R1
Q11
U3
R4
R19
CR11
CR12
CR13
R25
R6
CR14
R15
U1
C12
C14
Q13
R5
R13
R14
U2
Q7
R16
R21
R18
Q6
R12
R10
Q5
Q4
R24
R11
C15
C6
Q2
R2
R3
R17
R20
Q8
R9
R7
Q3
C9
C11
R22
C2
C1
C3
C4
VR1

Figure 5-4. A2 Power Supply PCB Assembly

Table 5-5. A3 Controller PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	⊘ CONTROLLER PCB ASSEMBLY FIGURE 5-5 (2200A-4036T)	409441	89536	409441	REF		
C1	CAP, CER, 10,000 PF -20/+80%, 25V	335786	72982	5835-000Y5-U103Z	3		
C2	CAP, MICA, 51 PF +/-5%, 500V	277210	72136	DM15E510J	1		
C3	CAP, CER, 10,000 PF -20/+80%, 25V	335786	72982	5835-000Y5-U103Z	REF		
C4	CAP, CER, 10,000 PF -20/+80%, 25V	335786	72982	5835-000Y5-U103Z	REF		
C5	CAP, TA, 2.2 UF +/-20%, 15V	364216	56289	196D225X0015HA1	2		
C6	CAP, TA, 2.2 UF +/-20%, 15V	364216	56289	196D225X0015HA1	REF		
C7	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	2		
C8	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C9	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253M	2		
C10	CAP, CER, 0.025 UF +/-20%, 100V	168435	56289	C023B101H253M	REF		
MP1	HOLDER, COMPONENT	422865	98159	2829-75-2	1		
Q1	XSTR, SI, PNP	229898	04713	MPS6522	1	1	
Q3	XSTR, SI, NPN	159855	07910	CS23030	1	1	
Q4	XSTR, SI, NPN	218081	04713	MPS6520	1	1	
R1	RES, DEP. CAR, 820 +/-5%, 1/4W	442327	80031	CR251-45P820E	2		
R2	RES, DEP. CAR, 820 +/-5%, 1/4W	442327	80031	CR251-45P820E	REF		
R3	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	6		
R4	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-45P5K6	2		
R5	RES, DEP. CAR, 5.6K +/-5%, 1/4W	442350	80031	CR251-45P5K6	REF		
R6	RES, DEP. CAR, 110 +/-5%, 1/4W	442285	80031	CR251-45P110E	4		
R7	RES, DEP. CAR, 110 +/-5%, 1/4W	442285	80031	CR251-45P110E	REF		
R8	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	4		
R10	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R11	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R12	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R15	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R17	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	2		
R18	RES, DEP. CAR, 110 +/-5%, 1/4W	442285	80031	CR251-45P110E	REF		
R19	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R20	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
R21	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R22	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R23	RES, DEP. CAR, 110 +/-5%, 1/4W	442285	80031	CR251-45P110E	REF		
R24	RES, DEP. CAR, 1K +/-5%, 1/4W	343426	80031	CR251-4-5P1K	REF		
R25	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	REF		
S1	SWITCH ASSEMBLY, 4-SPST	408559	00779	435166-2	4	1	
S2	SWITCH ASSEMBLY, 4-SPST	408559	00779	435166-2	REF		
S3	SWITCH ASSEMBLY, 4-SPST	408559	00779	435166-2	REF		
S4	SWITCH ASSEMBLY, 4-SPST	408559	00779	435166-2	REF		
U1	IC, TTL, HEX INVERTER	418004	01295	SN74S04N	1	1	
U2	⊘ IC, C-MOS, CLOCK DRIVER	408567	12040	MH0026CN	1	1	
U3	NOT SUPPLIED, ORDER PER NOTE 1 ON	FINAL	ASSY.				
U4	NOT SUPPLIED, ORDER PER NOTE 1 ON	FINAL	ASSY.				
U5	NOT SUPPLIED, ORDER PER NOTE 1 ON	FINAL	ASSY.				
U6	NOT USED						
U7	IC, TTL, QUAD, 2-INPUT NAND GTE	363580	01295	SN74S00N	1	1	
U8	IC, TTL, 4-BIT COUNTER	340463	01295	SN74163N	1	1	
U9	⊘ IC, C-MOS, 4-BIT CPU	404418	34649	C4040	1	1	

Table 5-5. A3 Controller PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U10	⊘ IC, C-MOS, STANDARD MEMORY INTERFACE	404434	34649	P4289CA	1	1	
U11	NOT SUPPLIED, ORDER PER NOTE 1 ON	FINAL	ASSY.				
U12	NOT SUPPLIED, ORDER PER NOTE 1 ON	FINAL	ASSY.				
U13	⊘ IC, C-MOS, QUAD, 2-INPUT NOR GATE	355172	04713	MC14001CP	1	1	
U14	IC, RES. NETWORK, 4.7K	387100	89536	387100	1	1	
U15	IC, LINE DECODER	408716	01295	SN74LS42N	2		
U16	IC, LINE DECODER	408716	01295	SN74LS42N	REF		
U17	RESISTOR, NETWORK CIRCUIT	446880	89536	446880	1		
U18	⊘ IC, C-MOS, DUAL J-K FLIP FLOP	355230	04713	MC14027CP	1	1	
U19	⊘ IC, P-MOS, 320-BIT RAM, 4-BIT OUTPUT	404467	34649	P4002-2	2	1	
U20	⊘ IC, P-MOS, 320-BIT RAM, 4-BIT OUTPUT	404442	34649	P4002-1	2	1	
U21	⊘ IC, P-MOS, 320-BIT RAM, 4-BIT OUTPUT	404442	34649	P4002-1	REF		
U22	IC, TTL, HEX INVERTER, OPEN COLLECTOR	394536	01295	SN74LS05N	2	1	
U23	IC, TTL, HEX INVERTER, OPEN COLLECTOR	394536	01295	SN74LS05N	REF		
U24	⊘ IC, C-MOS, TRIPLE 3-INPUT NOR GATE	355180	04713	MC14025CP	1	1	
U25	IC, RES. NETWORK, 10K	364000	89536	364000	1	1	
U27	⊘ IC, C-MOS, HEX BUFFER	407759	12040	MM80C97N	1	1	
U28	IC, RES. NETWORK, 22K	376962	89536	376962	1	1	
U29	⊘ IC, C-MOS, DUAL 4-INPUT NAND GATE	355206	04713	MC14012CP	1	1	
U30	⊘ IC, C-MOS, QUAD, 2-INPUT	413211	89536	413211	1		
U31	⊘ IC, P-MOS, 320-BIT RAM, 4-BIT OUTPUT	404467	34649	P4002-2	REF		
XU3	SOCKET, IC, 24-PIN	418970	91506	324-AG39D	6		
XU4	SOCKET, IC, 24-PIN	418970	91506	324-AG39D	REF		
XU5	SOCKET, IC, 24-PIN	418970	91506	324-AG39D	REF		
XU6	SOCKET, IC, 24-PIN (EMPTY)	418970	91506	324-AG39D	REF		
XU9	SOCKET, IC, 14-PIN	418970	91506	324-AG39D	REF		
XU10	SOCKET, IC, 40-PIN	418988	91506	340-AG39D	1		
XU11	SOCKET, IC, 24-PIN	418970	91506	324-AG39D	REF		
XU12	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	5		
XU19	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU20	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU21	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
XU31	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	REF		
Y1	CRYSTAL, 5.185 MHZ	408518	89536	408518	1	1	

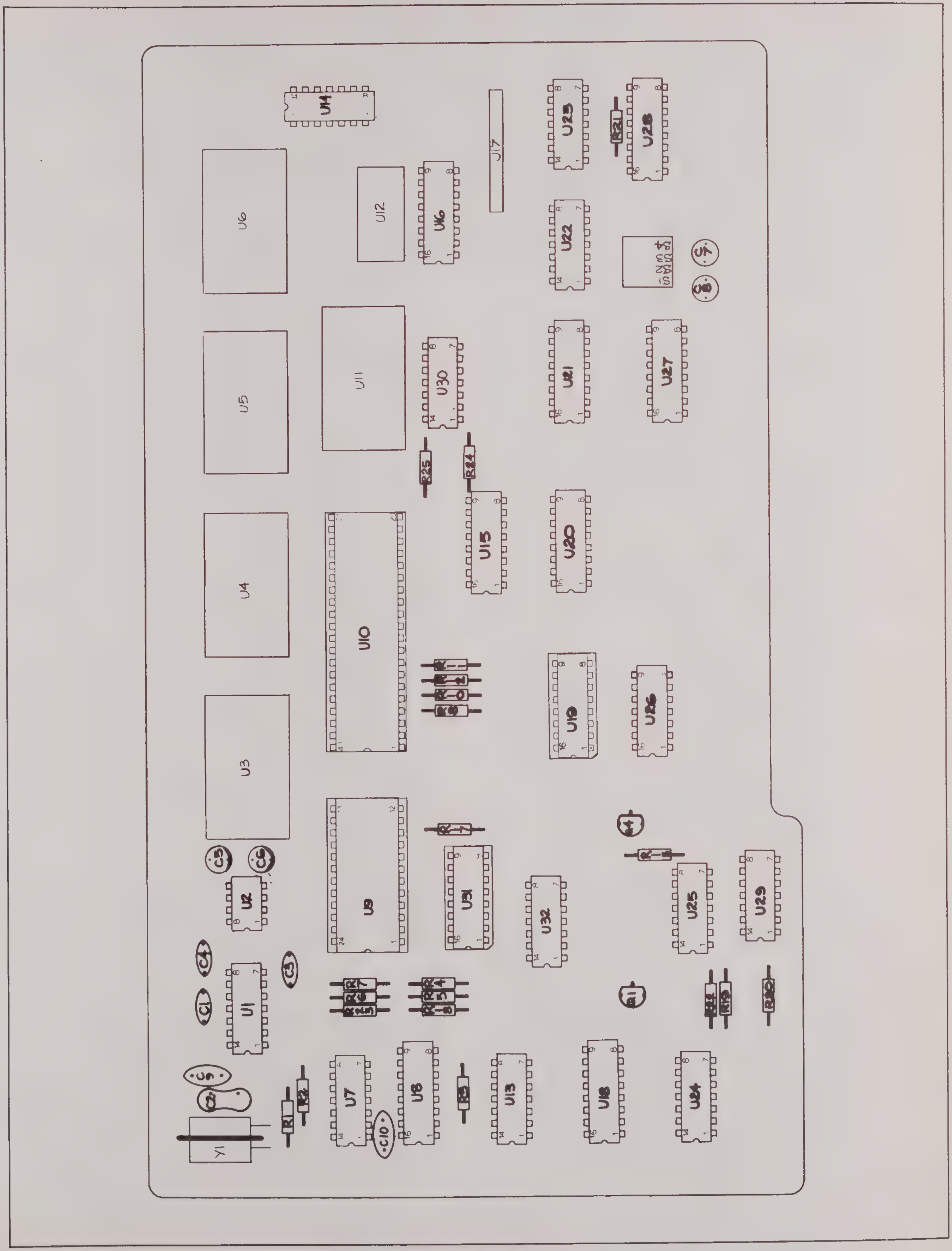

U14
U6
U12
U16
J17
U23
R21
U28
U22
C8
C7
U5
U11
U30
U21
U27
R25
R24
U4
U15
U20
U10
R1
R2
R10
R9
U19
U26
U3
R7
Q4
R18
C5
C6
U2
U9
U31
U32
U25
U29
C4
C3
C1
U1
R6
R12
R13
R4
R5
R3
Q1
R22
R19
R20
C9
C2
Y1
R1
R2
U7
C10
U8
R23
U13
U18
U24

Figure 5-5. A3 Controller PCB Assembly

Table 5-6. A4 Guard Crossing PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A4	⊗ GUARD CROSSING PCB ASSEMBLY FIGURE 5-6 (2200A-4004T)	409458	89536	409458	REF		
C1	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	11		
C2	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C3	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C4	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C5	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C6	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C7	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C8	CAP, CER, 100 PF +/-10%, 1 KV	105593	71590	DD101	1		
C9	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C10	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C11	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C12	CAP, TA, 10 UF +/-20%, 35V	330662	56289	196D106X0035KA1	2		
C13	CAP, CER, 5000 PF +/-20%, 100V	175232	56289	C023B101E502M	REF		
C14	CAP, TA, 10 UF +/-20%, 35V	330662	56289	196D106X0035KA1	REF		
C20	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	2		
C21	CAP, TA, 0.22 UF +/-20%, 35V	161331	56289	196D224X0035HA1	REF		
Q1	XSTR, SI, NPN	218396	04713	2N3904	5	5	
Q2	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q4	XSTR, SI, NPN	218396	04713	2N3904	REF		
Q23	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	5		
R2	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	5		
R3	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	REF		
R4	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	REF		
R5	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	REF		
R6	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	5		
R7	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R8	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R9	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R10	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R11	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R12	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	2		
R13	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	REF		
R14	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R15	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R16	RES, COMP, 330 +/-5%, 1/4W	147967	01121	CB3315	REF		
R20	RES, COMP, 22K +/-5%, 1/4W	348870	01121	CB2235	1		
R21	RES, MF, 100K +/-1%, 1/8W	248807	91637	MFF1-81003F	1		
R23	RES, COMP, 3K +/-5%, 1/4W	193508	01121	CB3025	REF		
U1	IC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	6	2	
U2	IC, TTL, QUAD, 2-INPUT POS. AND GATE	393066	01295	SN74LS08N	1	1	
U3	IC, TTL, QUAD, D-TYPE FLIP-FLOP	408203	12040	DM85L51N	1	1	
U4	IC, TTL, BCD COUNTER WITH LATCH	408195	12040	DM85L52N	4	1	
U5	IC, TTL, BCD COUNTER WITH LATCH	408195	12040	DM85L52N	REF		
U6	IC, TTL, BCD COUNTER WITH LATCH	408195	12040	DM85L52N	REF		
U7	IC, TTL, BCD COUNTER WITH LATCH	408195	12040	DM85L52N	REF		
U8	⊗ IC, COS/MOS, QUAD, BILATERAL SWITCH	363838	02735	CD4016AE	1	1	

Table 5-6. A4 Guard Crossing PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U9	OPTO-ISOLATOR	429894	28480	5082-4355	5	1	
U10	IC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	REF		
U11	IC, TTL, QUAD, 2-INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U12	IC, TTL, TRIPLE 3-INPUT NAND GATE	393074	01295	SN74LS10N	2	1	
U13	IC, TTL, QUAD 2-INPUT EXCLUSIVE -OR GATE	408237	01295	SN74LS86N	1	1	
U14	TC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	REF		
U15	⊘ IC, COS/MOS, HEX BUFFER/CONVERTER	381848	02735	CD4049AE	3	1	
U16	⊘ IC, C-MOS, DUAL 4-BIT STATIC SHIFT RGSTR	340125	04713	MC14015CP	1	1	
U17	⊘ IC, C-MOS, DUAL D-TYPE FLIP-FLOP	340117	04713	MC14013L	5	1	
U18	IC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	REF		
U19	IC, TTL DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	2	1	
U20	IC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	REF		
U21	IC, TTL, TRIPLE 3-INPUT NOR GATE	393090	01295	SN74LS27N	1	1	
U22	IC, TTL, QUAD, 2-INPUT NOR GATE	393041	01295	SN74LS02N	2	1	
U23	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	2	1	
U24	⊘ IC, C-MOS, DUAL D-TYPE FLIP-FLOP	340117	04713	MC14013L	REF		
U25	IC, TTL, QUAD, 2-INPUT NOR GATE	393041	01295	SN74LS02N	REF		
U26	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U27	IC, TTL, TRIPLE 3-INPUT NAND GATE	393074	01295	SN74LS10N	REF		
U28	IC, TTL, DUAL ONE-SHOT	404186	01295	SN74LS123LN	1	1	
U29	IC, TTL DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	REF		
U30	⊘ IC, COS/MOS, HEX BUFFER/CONVERTER	381848	02735	CD4049AE	REF		
U31	RES, NETWORK	494690	89536	494690	2	1	
U32	OPTO-ISOLATOR	429894	28480	5082-4355	REF		
U34	IC, TTL, DECADE COUNTER	402545	01295	SN74LS90N	1	1	
U35	IC, TTL, TRPL 3-INPUT POS. NAND GATE	393157	01295	SN74LS107N	REF		
U36	RES, NETWORK	408302	89536	408302	2	1	
U37	OPTO-ISOLATOR	429894	28480	5082-4355	REF		
U38	OPTO-ISOLATOR	407742	28480	HP5082-4351	1	1	
U39	OPTO-ISOLATOR	429894	28480	5082-4355	REF		
U40	OPTO-ISOLATOR	429894	28480	5082-4355	REF		
U42	⊘ TC, COS/MOS, QUAD, 2-INPUT NOR GATE	355172	02735	CD4001AC	2	1	
U43	⊘ IC, C-MOS, DUAL D-TYPE FLIP-FLOP	340117	04713	MC14013L	REF		
U44	RES, NETWORK	494690	89536	494690	REF		
U45	⊘ IC, C-MOS, STROBED HEX INVERTER	408211	04713	MC14502CP	1	1	
U46	⊘ IC, C-MOS, DUAL D-TYPE FLIP-FLOP	340117	04713	MC14013L	REF		
U47	⊘ IC, C-MOS, DUAL D-TYPE FLIP-FLOP	340117	04713	MC14013L	REF		
U48	⊘ IC, DGTL, C-MOS, NAND GATES QUAD 2-INPUT	355198	02735	CD4011AE	1	1	
U49	⊘ IC, COS/MOS, QUAD, 2-INPUT NOR GATE	355172	02735	CD4001AC	REF		
U50	⊘ IC, COS/MOS, HEX BUFFER/CONVERTER	381848	02735	CD4049AE	REF		
U51	⊘ IC, COS/MOS, NOR-GATES DUAL 4-INPUT	363820	02735	CD4002AE	2	1	
U52	RES, NETWORK	408302	89536	408302	REF		
U53	⊘ IC, C-MOS QUAD CLOCKED D LATCH TRI-STATE	412742	12040	MM74C173N	1	1	
U54	⊘ IC, COS/MOS, NOR-GATES DUAL 4-INPUT	363820	02735	CD4002AE	REF		
U55	TRANSISTOR ARRAY	454116	01295	UNN2003AN	1	1	
XY1	SOCKET CRYSTAL (EMPTY)	148668	91506	8000-AG10	1	1	
Y1	CRYSTAL, (SEE FINAL ASSY. FIG. 5-1)						

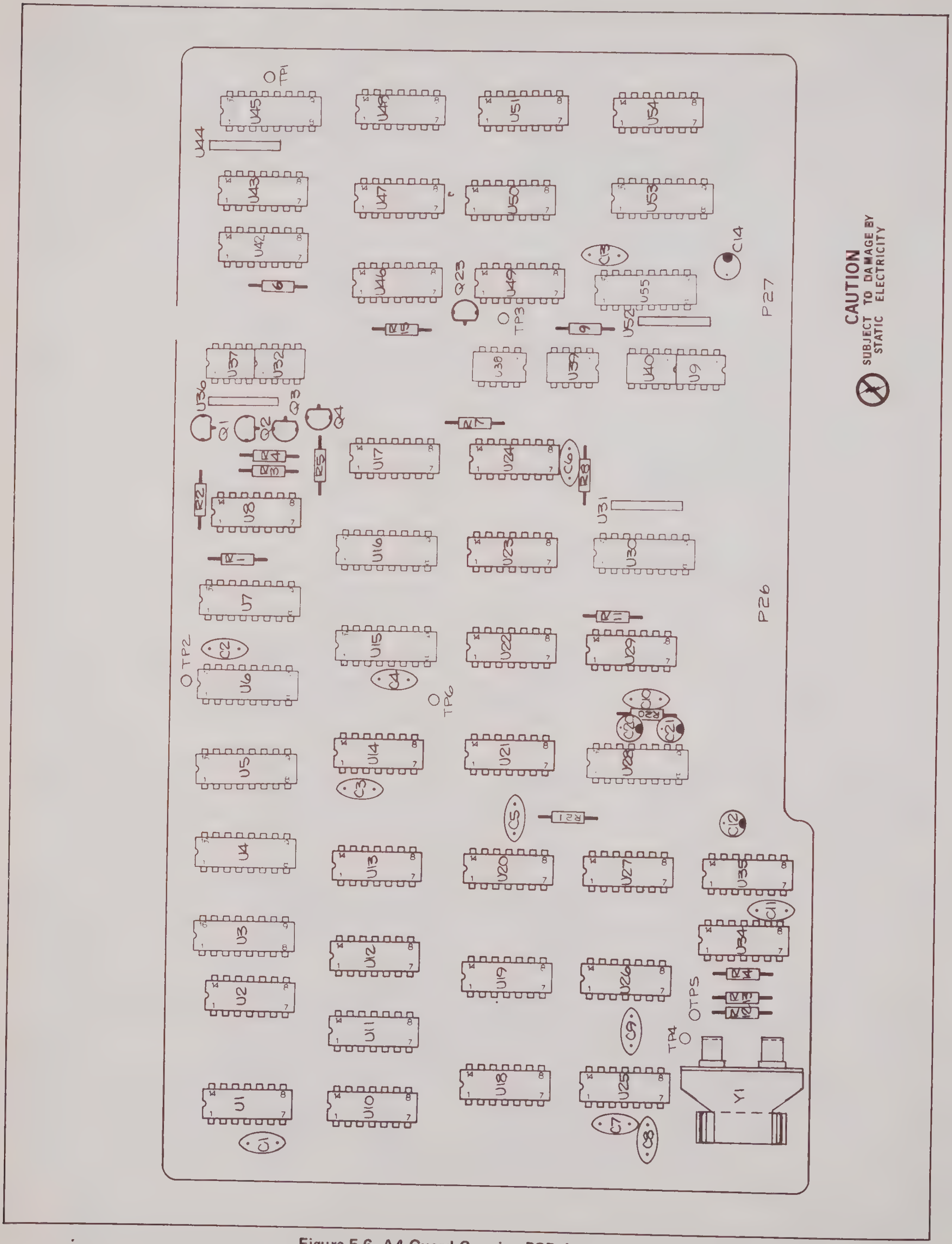

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY
TP1
U45
U48
U51
U54
U44
U43
U47
U50
U53
U42
U46
Q23
U49
C13
U55
C14
P27
R6
R15
TP3
R9
U52
U37
U32
U38
U39
U40
U9
U36
Q1
Q2
Q3
Q4
R7
R4
R3
R5
U17
U24
C6
R8
R2
U8
U31
U16
U23
U30
R1
U7
P26
R11
U15
U22
U29
C2
TP2
U6
C4
TP6
C10
R20
C20
C21
U14
U21
U28
U5
C3
C5
R21
C12
U4
U13
U20
U27
U35
C11
U3
U12
U19
U26
U34
R14
TP5
R13
R12
U2
C9
TP4
U11
U1
U10
U18
U25
Y1
C7
C8
C1

Figure 5-6. A4 Guard Crossing PCB Assembly

Table 5-7. A5 Printer Drive PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	⊗ PRINTER DRIVE PCB ASSEMBLY FIGURE 5-7 (2200A-4007T)	409482	89536	409482	REF		
C1	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	6		
C2	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C3	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C4	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C5	CAP, CER, 10,000 PF +/-20%, 100V	149153	56289	C023B101F103M	2		
C6	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C7	CAP, ELECT, 330 UF -10/+50%, 16V	187765	73445	ET331X016A02	1	1	
C8	CAP, CER, 10,000 PF +/-20%, 100V	149153	56289	C023B101F103M	REF		
C9	CAP, CER, 50,000 PF +/-20%, 100V	149161	56289	55C23A1	REF		
C10	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	5		
C11	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C12	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C13	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
C14	CAP, CER, 25,000 PF +/-20%, 100V	168435	56289	C023B101H253M	REF		
J4	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	2		
J6	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	REF		
P41	CONTACT, 15-PIN	424135	27264	09-64-1152	1		
Q1	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, COMP, 5.1K +/-5%, 1/4W	193342	01121	CB5125	1		
R2	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	4		
R3	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R4	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R5	RES, COMP, 18K +/-5%, 1/4W	148122	01121	CB1835	2		
R6	RES, COMP, 2K +/-5%, 1/4W	202879	01121	CB2025	2		
R7	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	REF		
R8	RES, COMP, 18K +/-5%, 1/4W	148122	01121	CB1835	REF		
R9	RES, COMP, 2K +/-5%, 1/4W	202879	01121	CB2025	REF		
R10	RES, COMP. 47K +/-5%, 1/4W	148163	01121	CB4735	2		
R11	RES, COMP. 47K +/-5%, 1/4W	148163	01121	CB4735	REF		
U1	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	2	1	
U2	IC, TTL, DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	4	1	
U3	IC, TTL, DUAL J-K FLIP-FLOP	414029	01295	SN74LS112N	1	1	
U4	IC, TTL, TRIPLE 3-INPUT NOR GATE	393090	01295	SN74LS27N	1	1	
U5	IC, TTL, DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	REF		
U6	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74LS02N	1	1	
U7	IC, TTL, DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	REF		
U8	IC, TTL 8-BIT PARALLEL OUT SER SHIFT REG	408732	01295	SN74LS164N	2	1	
U9	IC, TTL 8-BIT PARALLEL OUT SER SHIFT REG	408732	01295	SN74LS164N	REF		
U10	⊗ IC, COS/MOS, HEX BUFFER	355412	02735	CD4010AE	1	1	
U11	⊗ IC, COS/MOS, HEX INVERTER	355214	02735	CD4009AE	1	1	
U12	IC, TTL, TRIPLE 3-INPUT NAND GATE	393074	01295	SN74LS10N	1	1	
U13	IC, TTL, QUAD 2-INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U14	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	9	2	
U15	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U16	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U17	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U18	IC, TTL, DUAL D-TYPE FLIP-FLOP	393124	01295	SN74LS74N	REF		
U19	IC, LIN, COMPARATOR	352195	01295	SN72311P	2	1	

Table 5-7. A5 Printer Drive PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U20	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U21	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U22	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U23	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U24	IC, TTL, DUAL PERIPHERAL NAND DRIVER	329706	01295	SN75452P	REF		
U25	⊘ IC, C-MOS, HEX TRI-STATE BUFFER	407759	04713	MC14503CP	1	1	
U26	IC, TTL, HEX INVERTER	393058	01295	SN74LS04N	REF		
U27	IC, LIN, COMPARATOR	352195	01295	SN72311P	REF		

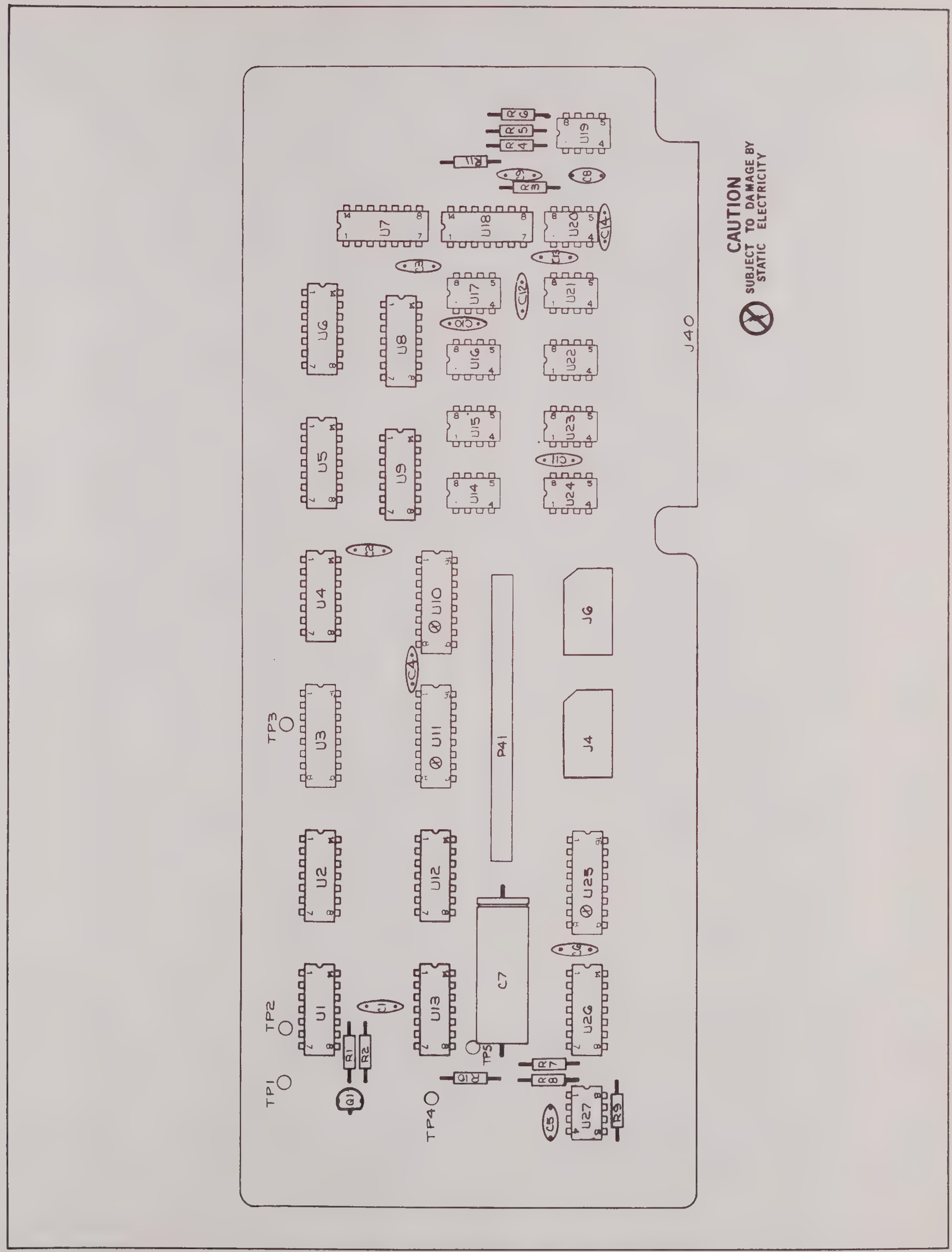

CAUTION
SUBJECT TO DAMAGE BY STATIC ELECTRICITY
J40
R6
R5
R4
U19
R11
R9
R3
C8
U7
U18
U20
C14
C13
C3
U17
C12
U21
Q2
U6
U8
U16
U22
U5
U9
U15
U23
C10
U14
U24
C2
U4
U10
J6
C4
TP3
U3
U11
P41
J4
U2
U12
U25
C6
C7
U1
U13
U26
TP2
C1
R1
R2
TP5
R7
R8
R10
TP1
Q1
TP4
U27
C5
R9

Figure 5-7. A5 Printer Drive PCB Assembly

Table 5-8. A6 Display PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	DISPLAY PCB ASSEMBLY FIGURE 5-8 (2200A-4008T)	409490	89536	409490	REF		
C3	CAP, CER, 100 PF +/-10%, 1 KV	105593	71590	DD-101	1		
C4	CAP, TA, 39 UF +/-20%, 6V	163915	56287	196D396X0006KA1	1		
C5	CAP, ELECT, TA, 33 UF +/-10%, 10V	182832	56289	150D336X9010B2	1	1	
CR1	DIODE, SI, SWITCHING	313247	28480	HP5082-6264	5	1	
CR2	DIODE, SI, SWITCHING	313247	28480	HP5082-6264	REF		
CR3	DIODE, SI, SWITCHING	313247	28480	HP5082-6264	REF		
CR4	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	12	3	
CR5	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR6	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR7	DIODE, SI, SWITCHING	313247	28480	HP5082-6264	REF		
CR8	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR10	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR11	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR12	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR13	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR14	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR15	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR16	DIODE, SI, HI-SPEED SWITCHING	203323	07910	1N4448	REF		
CR17	DIODE, SI, SWITCHING	313247	28480	HP5082-6264	REF		
CR18	DIODE, LIGHT-EMITTING	428623	12040	59NSL-5046	3	1	
CR19	DIODE, LIGHT-EMITTING	428623	12040	59NSL-5046	REF		
CR20	DIODE, LIGHT-EMITTING	428623	12040	59NSL-5046	REF		
DS2	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	8	2	
DS3	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS4	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS5	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS6	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS7	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS8	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
DS9	LED, DISPLAY, 7-SEGMENT	418012	28480	5082-7651	REF		
J43	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	1		
MP1	DECAL, PART NO. (NOT SHOWN)	409250	89536	409250	1		
Q2	XSTR, SI, PNP	352369	12040	2N4403	9	2	
Q3	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q5	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q6	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q7	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q8	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q9	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q10	XSTR, SI, PNP	352369	12040	2N4403	REF		
Q11	XSTR, SI, PNP	352369	12040	2N4403	REF		
R2	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	4		
R3	RES, DEP. CAR, 6.8K +/-5%, 1/4W	368761	80031	CR251-4-5P6K8	1		
R5	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	REF		
R7	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	REF		
R11	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	5		
R13	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		

Table 5-8. A6 Display PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R17	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R19	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R23	RES, DEP. CAR, 51 +/-5%, 1/4W	414540	80031	CR251-4-5P51E	REF		
R25	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	REF		
R29	RES, DEP. CAR, 33 +/-5%, 1/4W	414524	80031	CR251-4-5P33E	1		
U1	IC, TTL, BCD-TO-7-SEGMENT DECODER/DRIVER	340109	01295	SN7447AN	2	1	
U2	RES, NETWORK	344069	89536	344069	2	1	
U3	IC, TTL, BCD-TO-DECIMAL DECODER/DRIVER	293175	01295	SN74145N	3	1	
U4	IC, TTL, BCD-TO-7-SEGMENT DECODER/DRIVER	340109	01295	SN7447AN	REF		
U5	RES, NETWORK	344069	89536	344069	REF		
U6	IC, TTL, BCD-TO-DECIMAL DECODER/DRIVER	293175	01295	SN74145N	REF		
U7	IC, TTL, QUAD 2-INPUT NOR GATE	393041	01295	SN74LS02N	1	1	
U8	IC, TTL, BCD-TO-DECIMAL DECODER/DRIVER	293175	01295	SN74145N	REF		
U9	RES, NETWORK	364018	89536	364018	1	1	
U10	RES, NETWORK	414557	89536	414557	2	1	
U11	RES, NETWORK	414557	89536	414557	REF		
XCR18	SOCKET, ANNUNCIATOR LED	436055	22526	65358-001	3		
XCR19	SOCKET, ANNUNCIATOR LED	436055	22526	65358-001	REF		
XCR20	SOCKET, ANNUNCIATOR LED	436055	22526	65358-001	REF		
XDS2	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	8		
XDS3	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS4	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS5	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS6	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS7	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS8	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		
XDS9	SOCKET, DISPLAY LED	387316	71785	133-59-02-059	REF		

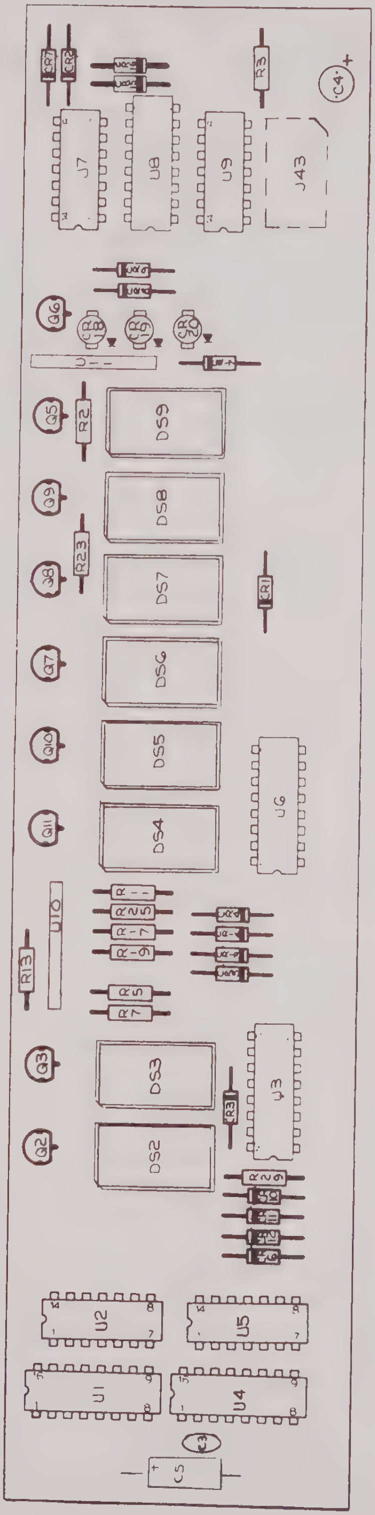
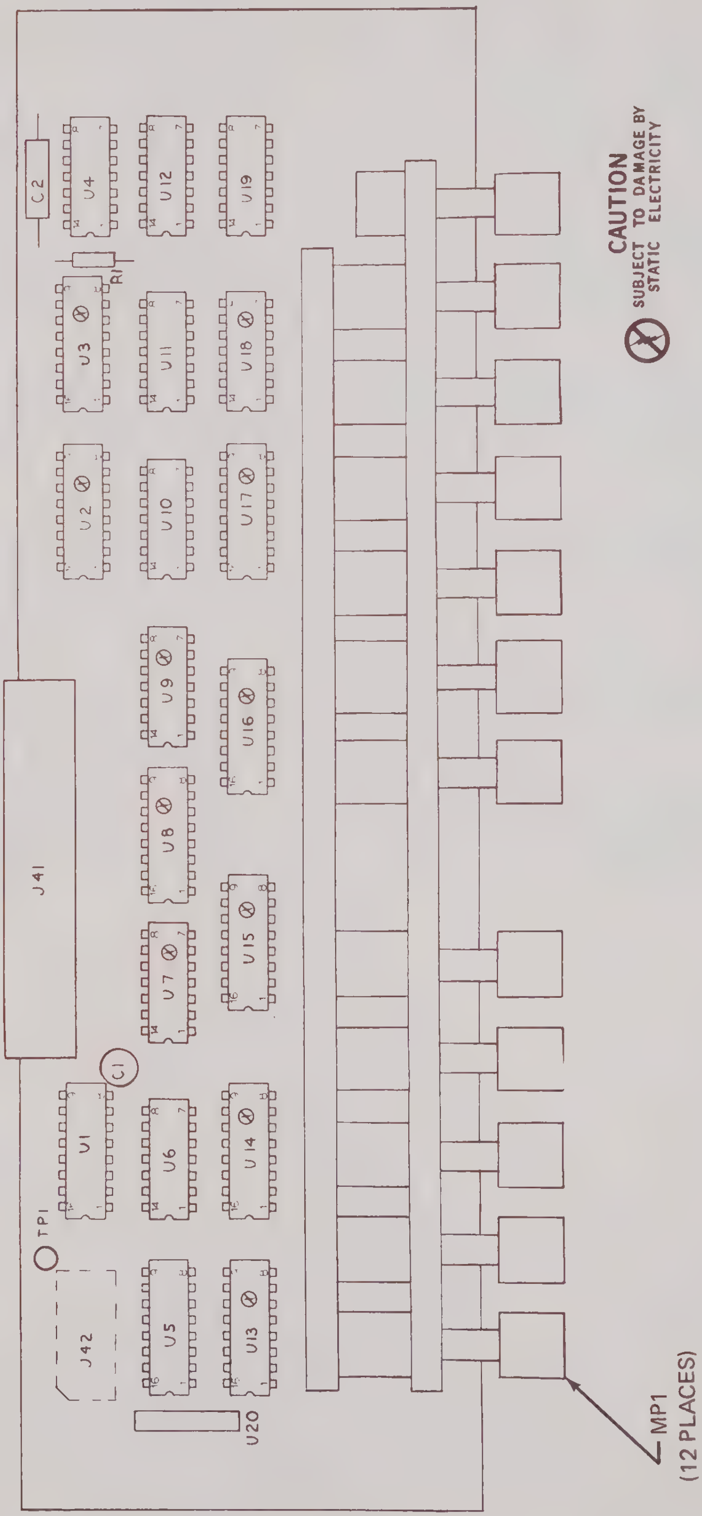

U7
U8
U9
J43
R3
C4
Q6
CR18
CR19
CR20
U11
Q5
R2
DS9
Q9
DS8
Q8
R23
DS7
CR1
Q7
DS6
Q10
DS5
Q11
DS4
U6
U10
R13
Q3
DS3
U3
Q2
DS2
U2
U5
U1
U4
C3
C5

Figure 5-8. A6 Display PCB Assembly

Table 5-9. A7 Mode Switch PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	⊘ MODE SWITCH ASSEMBLY FIGURE 5-9 (2200B-4009T)	502229	89536	502229	REF		
C1	CAP, TA, 22 UF +/-20%, 25V	357780	56289	196D226X0025PE4	1		
C2	CAP, MYLAR, 0.0047 UF +/-20%, 200V	106054	56289	192P47202	1		
J41	CONN, PCB MOUNT	414375	27264	09-52-3151	1		
J42	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	1		
MP1	PUSHBUTTON, SMALL	412163	89536	412163	12		
MP2	SPACER, PCB STANDOFF (NOT SHOWN)	295246	71590	J64286	9		
R1	RES, DEP. CAR, 47K +/-5%, 1/4W	348896	80031	CR251-45P47K	1		
U1	IC, MSI, SYNCHR, 4-BIT UP/DOWN COUNTER	393231	01295	SN74LS193N	1	1	
U2	⊘ IC, COS/MOS, DUAL J-K MSTR-SLAVE F/F	355230	04713	MC14027BCP	1	1	
U3	⊘ IC, C-MOS, HEX/BUFFER INVERTERS	381848	04713	MC14049CP	3	1	
U4	IC, MSL, MONOSTBL MULTIVIBRATOR	293134	04713	MC8601P	1	1	
U5	IC, TTL, 64-BIT READ/WRITE MEMORY	408583	01295	SN7489N	1	1	
U6	RES, NETWORK, 15K +/-5%, 1/4W	352054	89536	352054	2		
U7	⊘ IC, COS/MOS, DUAL 4-INPUT NOR GATES	363820	04713	MC14002CP	1	1	
U8	⊘ IC, C-MOS, HEX/BUFFER INVERTERS	381848	04713	MC14049CP	REF		
U9	⊘ IC, C-MOS, TRIPLE 3-INPUT OR GATES	408575	02735	CD4075BE	1	1	
U10	RES, NETWORK, 15K +/-5%, 1/4W	352054	89536	352054	REF		
U11	IC, TTL, DUAL J-K NEG-EDGE-TRIG F/F	393157	01295	SN74LS107N	1	1	
U12	IC, TTL, QUAD, 2-INPUT POS NAND GATES	393033	01295	SN74LS00N	2	1	
U13	⊘ IC, C-MOS, HEX/BUFFER INVERTERS	381848	04713	MC14049CP	REF		
U14	⊘ IC, C-MOS, HEX BUFFER INVERTER	381830	04713	MC14050CP	2	1	
U15	⊘ IC, C-MOS, TRI-ST NON-INVRT HEX/BUFFERS	407759	04713	MC14503CP	2	1	
U16	⊘ IC, C-MOS, TRI-ST NON-INVRT HEX/BUFFERS	407759	04713	MC14503CP	REF		
U17	⊘ IC, C-MOS, HEX BUFFER INVERTER	381830	04713	MC14050CP	REF		
U18	⊘ IC, COS/MOS, QUAD, 2-INPUT NOR GATES	355172	04713	MC14001CP	1	1	
U19	IC, TTL, QUAD, 2-INPUT POS NAND GATES	393033	01295	SN74LS00N	REF		
U20	RES, NETWORK, 1K +/-2%	408310	89536	408310	1	1	


C2
U4
U12
U19
R1
U3
U11
U18
U2
U10
U17
U9
U16
U8
J41
U15
U7
C1
U1
U6
U14
TP1
J42
U5
U13
U20
CAUTION
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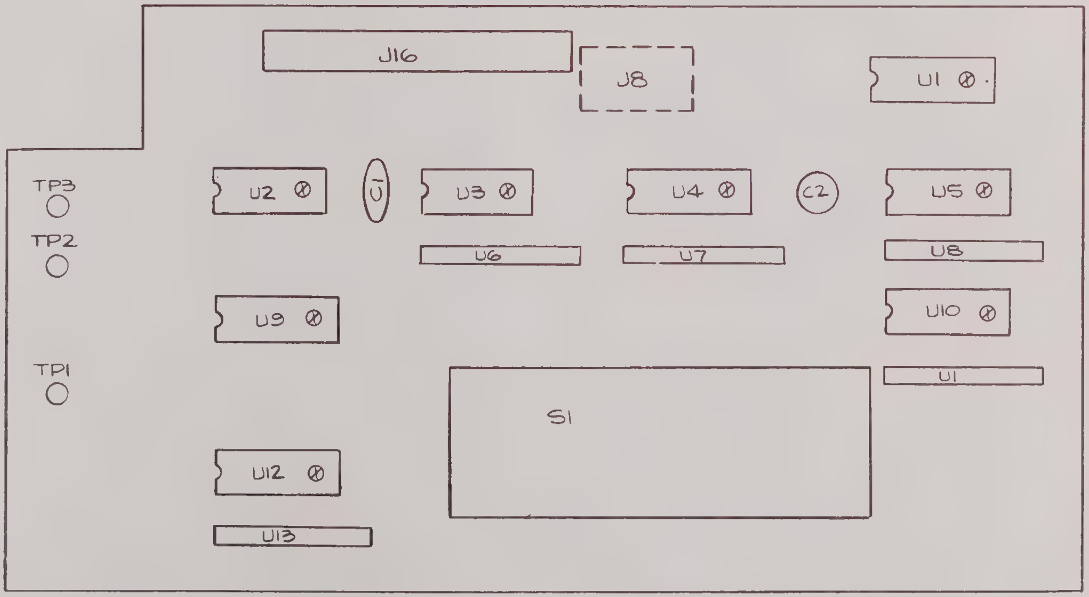
MP1
(12 PLACES)

Figure 5-9. A7 Mode Switch PCB Assembly

Table 5-10. A8 Basic Programmer PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	⊗ BASIC PROGRAMMER ASSEMBLY FIGURE 5-10(2200B-4010T)	502260	89536	502260	REF		
C1	CAP, CER, 0.05 UF +/-20%, 50V	149161	56289	55C23C1	1		
C2	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015A1	1		
J8	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	1		
J16	CONNECTOR, 12-PIN	501635	89536	501635	1		
S1	SWITCH ASSEMBLY, THUMBWHEEL	504381	53985	IS01798	1		
U1	⊗ IC, C-MOS, HEX INVERTER/BUFFER	408211	04713	MC14502BCP	1	1	
U2	⊗ IC, C-MOS, DUAL 4-INPUT NAND GATE	355206	04713	MC14012CP	1	1	
U3	⊗ IC, C-MOS, QUAD, 2-INPUT NAND SCHMT TRIG	404632	02735	CD4093BE	1	1	
U4	⊗ IC, C-MOS, ANALOG MLTPLXR/DMLTPLXR	452805	02735	CD4051BE	4	1	
U5	⊗ IC, C-MOS, ANALOG MLTPLXR/DMLTPLXR	452805	02735	CD4051BE	REF		
U6	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	5	1	
U7	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
U8	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
U9	⊗ IC, C-MOS, DUAL UP COUNTER	355164	04713	MC14520BCP	1	1	
U10	⊗ IC, C-MOS, ANALOG MLTPLXR/DMLTPLXR	452805	02735	CD4051BE	REF		
U11	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
U12	⊗ IC, C-MOS, ANALOG MLTPLXR/DMLTPLXR	452805	02735	CD4051BE	REF		
U13	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		



⊗ **CAUTION**
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Figure 5-10. A8 Basic Programmer PCB Assembly

Table 5-11. A9 Block Programmer/Memory PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	⊗ BLOCK PROGRAMMER/MEMORY ASSEMBLY FIGURE 5-11 (2200B-4031T)	502278	89536	502278	REF		
C1	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	1		
C2	CAP, CER, 0.05 UF +/-20%, 50V	149161	56289	55C23C1	1		
CR1	DIODE, HI-SPEED SWITCH	203323	07910	1N4448	1	1	
J10	SOCKET, IC, 14-PIN	387316	71785	133-59-02-059	1		
MP1	BLOCK PROGRAMMER	302211	89536	302211	1		
MP2	CONNECTOR, (ON BLK & RED WIRES)	294975	89536	294975	2		
P16	CONN, PCB	417741	27264	09-52-3123	1		
Q1	XSTR, J-FET, N-CHANNEL	370072	89536	370072	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	6		
R2	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	1		
R3	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	REF		
R4	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	REF		
R5	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	1		
R6	RES, DEP. CAR, 15K +/-5%, 1/4W	348854	80031	CR251-4-5P15K	2		
R7	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	REF		
R8	RES, DEP. CAR, 15K +/-5%, 1/4W	348854	80031	CR251-4-5P15K	REF		
R9	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	REF		
R10	RES, COMP, 6.8K +/-5%, 1/4W	148098	01121	CB6825	REF		
S1	SWITCH ASSEMBLY						
	PUSHBUTTON, ORANGE	420620	89536	420620	3		
	PUSHBUTTON, GREY	406819	89536	406819	1		
	SWITCH COVER	401299	89536	401299	4		
	SWITCH ACTUATOR	412106	89536	412106	4		
	SWITCH SPRING	416875	89536	416875	4		
	SWITCH CONTACT	414516	89536	414516	4		
U6	⊗ IC, C-MOS, 1024 BIT, STATIC RAM	429860	34649	PT5101L	1	1	
U7	⊗ IC, C-MOS, TRI-ST NON-INVRT HEX/BUFFERS	407759	04713	MC14503CP	2	1	
U8	⊗ IC, C-MOS, TRI-ST NON-INVRT HEX/BUFFERS	407759	04713	MC14503CP	REF		
U9	⊗ IC, C-MOS, HEX BUFFER/INVERTERS	381848	04713	MC14049CP	1	1	
U10	RES, NETWORK, 100K +/-2%	412908	89536	412908	4	1	
U11	RES, NETWORK, 100K +/-2%	412908	89536	412908	REF		
U12	RES, NETWORK, 100K +/-2%	412908	89536	412908	REF		
U13	RES, NETWORK, 100K +/-2%	412908	89536	412908	REF		
XU6	SOCKET, IC, 22-PIN	453126	91506	322-AG39D	1		

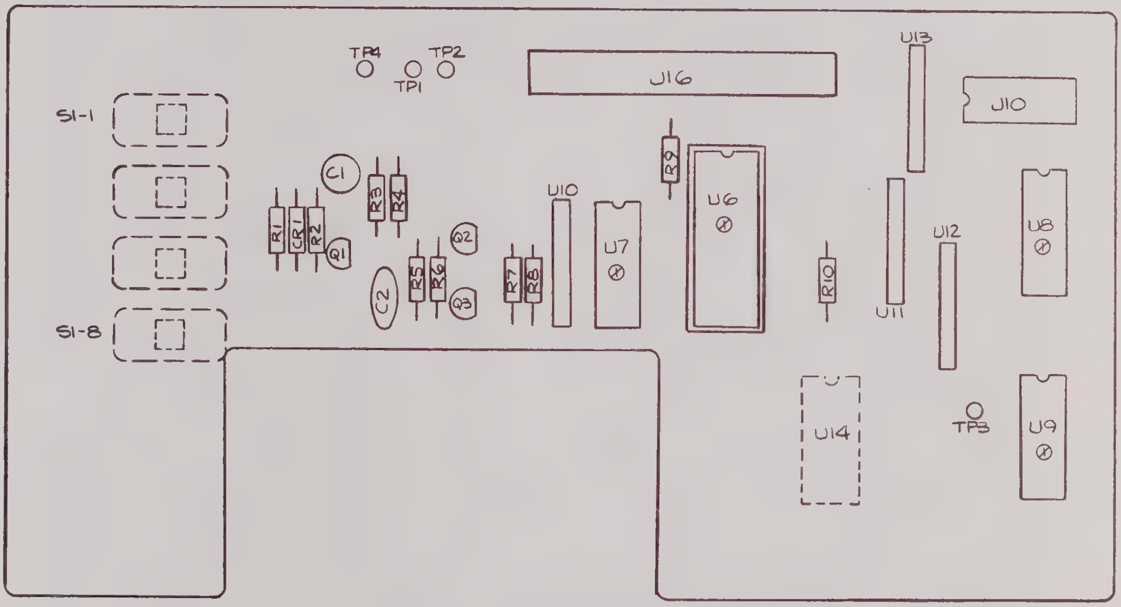
TP4
TP1
TP2
J16
U13
J10
S1-1
S1-8
C1
R1
CR1
R2
Q1
R3
R4
Q2
C2
R5
R6
Q3
R7
R8
U10
U7
R9
U6
R10
U11
U12
U8
U14
TP3
U9

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Figure 5-11. A9 Block Programmer/Memory PCB Assembly

Table 5-12. A10 High Performance A/D Converter PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	⊘ HIGH PERFORMANCE A/D CONVERTER PCB ASSY FIGURE 5-12 (2200A-4028T)	409409	89536	409409	1		
C1	CAP, POLY PROPLYN, 0.033 UF +/-10%, 50V	424218	89536	424218	2		
C2	CAP, POLY PROPLYN, 0.22 UF +/-10%, 50V	423210	89536	423210	2		
C3	CAP, MICA, 4 PF +/-0.5 PF, 500V	190397	72136	DM15C040K	2		
C4	CAP, CER, 500 PF +/-10%, 1KV	105692	71590	2DDH60N501K	3		
C5	CAP, CER, 500 PF +/-10%, 1KV	105692	71590	2DDH60N501K	REF		
C6	CAP, POL CAR, 2.2 UF +/-10%, 100V	306522	73445	C280MCH/A2M2	3		
C7	CAP, POL CAR, 2.2 UF +/-10%, 100V	306522	73445	C280MCH/A2M2	REF		
C8	CAP, POL CAR, 2.2 UF +/-10%, 100V	306522	73445	C280MCH/A2M2	REF		
C9	CAP, POLY PROPLYN, 0.47 UF +/-10%, 50V	363085	89536	363085	1		
C10	CAP, CER, 0.0027 UF +/-GMV, 600V	106211	56289	5GA-D33	1		
C11	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020XA1	3		
C12	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020XA1	REF		
C13	CAP, TA, 10 UF +/-20%, 20V	330662	56289	196D106X0020XA1	REF		
C14	CAP, POLY PROPLYN, 0.033 UF +/-10%, 50V	424218	89536	424218	REF		
C15	CAP, POLY PROPOLYN, 0.22 UF +/-10%, 50V	423210	89536	423210	REF		
C16	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J1	1		
C17	CAP, MICA, 4 PF +/-0.5 PF, 500V	190397	72136	DM15C040K	REF		
C18	CAP, MICA, 120 PF +/-5%, 500V	148486	72136	DM15F121J	1		
C19	CAP, CER, 500 PF +/-10%, 1KV	105692	71590	2DDH60N501K	REF		
C20	CAP, POLY PROPLYN, 0.068 UF +/-10%, 50V	424226	89536	424226	1		
C21	CAP, POLY PROPLYN 0.039 UF +/-10%, 50V	424234	89536	424234	1		
C22	CAP, CER, 0.005 UF +/-20%, 50V	255471	51642	200-050-601-502M	1		
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	6	2	
CR7	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR11	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR12	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
H1	LOCKWASHER, SPLIT #4 (NOT SHOWN)	110395	89536	110395	2		
H2	NUT, HEX, 4-40 (NOT SHOWN)	147611	89536	147611	2		
H3	SCREW, PHP, 4-40 X 3/8 (NOT SHOWN)	152124	73734	19024	2		
J15	CONNECTOR, REAR PANEL, 36-PIN	414409	00779	552241-1	1		
J29	CONNECTOR SOCKET, IC, 14-PIN DIP	387316	71785	135-59-02-059	1		
K1	RELAY	404061	71707	CR-3201-5-710	1		
MP1	DECAL, PART NO. (NOT SHOWN)	406405	89536	406405	1		
MP2	HARDWARE, CONNECTOR MOUNTING, J15	448563	00779	552565-2	1		
Q1	XSTR, J-FET, N-CHANNEL	357905	89536	357905	22	5	
Q2	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q3	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q4	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q5	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q6	XSTR, J-FET, N-CHANNEL	376475	89536	376475	5	1	
Q7	XSTR, J-FET, N-CHANNEL	376475	89536	376475	REF		
Q8	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q9	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q10	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q11	XSTR, J-FET, N-CHANNEL	376475	89536	376475	REF		
Q12	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		

Table 5-12. A10 High Performance A/D Converter PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q13	XSTR, FET, DUAL, N-CHANNEL	376087	89536	376087	1	1	
Q14	XSTR, FET, DUAL, N-CHANNEL	379321	89536	379321	1	1	
Q15	XSTR, J-FET, N-CHANNEL	376475	89536	376475	REF		
Q16	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q17	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q18	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q19	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q20	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q21	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q22	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q30	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q31	XSTR, J-FET, N-CHANNEL	376475	89536	376475	REF		
Q32	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q33	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q34	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q35	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q36	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
Q37	XSTR, J-FET, N-CHANNEL	357905	89536	357905	REF		
R1	RES, NETWORK	375105	89536	375105	2	1	
R2	RES, NETWORK	375105	89536	375105	REF		
R3	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	2		
R4	RES, VAR, 500 +/-10%, 1/2W	291120	89536	291120	3	1	
R5	RES, COMP, 39K +/-5%, 2W	424721	01121	HB3935	1		
R7	RES, VAR, CER, 50K +/-10%, 1/2W	288290	89536	288290	3		
R8	RES, MF, 2K +/-0.1%, 1/8W	340174	91637	MFF1-82001B	1		
R9	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	6		
R10	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R11	RESISTOR, SELECTED, SEE VR5						
R12	RES, VAR, 500 +/-10%, 1/2W	291120	89536	291120	REF		
R13	RESISTOR, SELECTED, SEE VR5				REF		
R14	RES, WW, 40K +/-0.2%, 1/2W	112037	89536	112037	1	1	
R15	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R16	RES, MF, 23.7K +/-1%, 1/8W	188367	91637	MFF1-82372F	1		
R17	RES, MF, 15K +/-1%, 1/8W	285296	91637	MFF1-81502F	2		
R18	RES, MF, 15K +/-1%, 1/8W	285296	91637	MFF1-81502F	REF		
R19	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R20	RES, MF, 130K +/-1%, 1/8W	221648	91637	MFF1-81303F	1		
R21	RES, VAR, CER, 50K +/-10%, 1/2W	288290	89536	288290	REF		
R22	RES, MF, 1M +/-1%, 1/8W	268797	91637	MFF1-81004F	1		
R23	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	10		
R24	RES, MF, 4.02K +/-1%, 1/8W	235325	91637	MFF1-84021F	1		
R25	RES, COMP, 1.5K +/-5%, 1/4W	148031	01121	CB1525	2		
R27	RES, COMP, 3.3M +/-5%, 1/4W	208389	01121	CB3355	1		
R28	RES, WW, 22.5K +/-0.1%, 1/2W	112045	89536	112045	1	1	
R29	RES, VAR, CER, 5K +/-10%, 1/2W	288282	89536	288282	1	1	
R30	RES, MF, 806K +/-1%, 1/8W	217976	91637	MFF1-88063F	1		
R31	RES, WW, 2K +/-1%, 1/2W	171843	89536	171843	1	1	
R32	RES, VAR, 500 +/-10%, 1/2W	291120	89536	291120	REF		
R33	RES, MF, 100K +/-1%, 1/8W	248807	91637	MFF1-81003F	2		
R34	RES, MF, 100K +/-1%, 1/8W	248807	91637	MFF1-81003F	REF		

Table 5-12. A10 High Performance A/D Converter PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R35	RES, WW, 250 +/-0.05%, 1/2W	182220	89536	182220	2	1	
R36	RES, VAR, CER, 1K +/-10%, 1/2W	285155	89536	285155	1	1	
R37	RES, WW, 99.975K	178780	89536	178780	1	1	
R38	RES, MF, 75K +/-1%, 1/8W	291443	91637	MFF1-87502	2		
R39	RES, WW, 1.022K +/-0.05%, 1/4W	288654	89536	288654	1	1	
R40	RES, WW, 250 +/-0.05%, 1/2W	182220	89536	182220	REF		
R41	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	1		
R42	RES, MF, 6.81K +/-1%, 1/8W	268417	91637	MFF1-86811F	2		
R43	RES, MF, 6.81K +/-1%, 1/8W	268417	91637	MFF1-86811F	REF		
R44	RES, VAR, CER, 20K +/-10%, 1/2W	291609	89536	291609	2	1	
R45	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R46	RES, VAR, CER, +/-10%, 1/2W	288290	89536	288290	REF		
R47	RES, MF, 75K +/-1%, 1/8W	291443	91637	MFF1-87502	REF		
R48	RES, MF, 56.2K +/-1%, 1/8W	271346	91637	MFF1-85622F	1		
R49	RES, MF, 14.3K +/-1%, 1/8W	291617	91637	MFF1-81432F	1		
R50	RES, VAR, CER, 200 +/-10%, 1/2W	285148	89536	285148	2	1	
R51	RES, COMP, 820K +/-5%, 1/4W	220541	01121	CB8245	1		
R52	RES, COMP, 680K +/-5%, 1/4W	188433	01121	CB6845	1		
R53	RES, COMP, 1.5K +/-5%, 1/4W	148031	01121	CB1525	REF		
R54	RES, VAR, CER, 200 +/-10%, 1/2W	285148	89536	285148	REF		
R55	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R56	RES, WW, 19.991K, 1/4W	277988	89536	277988	1	1	
R57	RES, COMP, 22K +/-5%, 1/4W	148130	01121	CB2235	REF		
R60	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	2		
R61	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	REF		
R63	RES, COMP, 1K +/-5%, 1/4W	148023	01121	CB1025	1		
R64	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	1		
R70	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R71	RES, COMP, 750 +/-5%, 1/4W	218024	01121	CB7515	2		
R72	RES, VAR, CER, 20K +/-10%, 1/2W	291609	89536	291609	REF		
R73	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R74	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R75	RES, COMP, 750 +/-5%, 1/4W	218024	01121	CB7515	REF		
R76	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R77	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R78	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R79	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R80	RES, COMP, 47K +/-5%, 1/4W	148163	01121	CB4735	REF		
R81	RES, COMP, 10M +/-5%, 1/4W	194944	01121	CB1065	2		
R82	RES, COMP, 10M +/-5%, 1/4W	194944	01121	CB1065	REF		
R83	RES, COMP, 100M +/-10%, 1/2W	190520	01121	EB1071	1		
R84	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
S1	SWITCH, SLIDE, DPDT						
	SLIDE SWITCH, BOTTOM-A	454777	10389	24-420-020	1		
	SLIDE SWITCH, TOP-B	454835	10389	24-420-020	1		
TP1	CONNECTOR, TEST POINT, FEMALE	170480	74970	105-752	3		
TP2	CONNECTOR, TEST POINT, FEMALE	170480	74970	105-752	REF		
TP3	CONNECTOR, TEST POINT, FEMALE	170480	74970	105-752	REF		
TP4	CONNECTOR, POST	267500	00779	861442	6		
TP5	CONNECTOR, POST	267500	00779	861442	REF		

Table 5-12. A10 High Performance A/D Converter PCB Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
TP6	CONNECTOR, POST	267500	00779	861442	REF		
TP7	CONNECTOR, POST	267500	00779	861442	REF		
TP8	CONNECTOR, POST	267500	00779	861442	REF		
TP9	CONNECTOR, POST	267500	00779	861442	REF		
U1	IC, LINEAR, DUAL	478032	04713	MC4558NCP1	2	1	
U2	IC, LINEAR, DUAL	478032	04713	MC4558NCP1	REF		
U3	IC, LINEAR, COMPARATOR	472894	12040	LM311N	1	1	
U4	IC, LINEAR, VOLTAGE REGULATOR	419044	49956	RC4195T	1	1	
U5	IC, LINEAR, OP AMP	284760	12040	LM308	1	1	
U6	IC, TTL QUAD, 2-INPUT & GATE (SELECTED)	412759	89536	412759	1	1	
U7	IC, XSTR, ARRAY (SELECTED)	413237	89536	413237	2	1	
U13	IC, TTL, DUAL, J-K FLIP-FLOP	393157	01295	SN74LS107N	1	1	
U14	IC, TTL, DECODER/DEMULTIPLEXER	393165	01295	SN74LS139	1	1	
U15	⊗ IC, C-MOS, 4-BIT REG W/TR-ST OUTPUTS	412742	12040	MM74C173N	4	1	
U16	⊗ IC, C-MOS, 4-BIT REG W/TR-ST OUTPUTS	412742	12040	MM74C173N	REF		
U17	⊗ IC, C-MOS, 4-BIT REG W/TR-ST OUTPUTS	412742	12040	MM74C173N	REF		
U18	⊗ IC, C-MOS, 4-BIT REG W/TR-ST OUTPUTS	412742	12040	MM74C173N	REF		
U19	⊗ IC, C-MOS, 8-INPUT OR GATE	418798	12040	MM4048AN	1	1	
U20	⊗ IC, C-MOS, 1-OF-10 DECODER	380741	86684	CD4028AE	1	1	
U21	⊗ IC, C-MOS, HEX, BUFFER, INVERTER	381830	86684	CD4050AE	1	1	
U22	IC, TTL, QUAD, 2-INPUT NAND GATE	393033	01295	SN74LS00N	1	1	
U23	RES, NETWORK, 100K	412726	89536	412726	2	1	
U24	RES, NETWORK, 100K	412726	89536	412726	REF		
U25	IC, LINEAR, OPNL, AMPL	418566	12040	LM358N	1	1	
U26	IC, XSTR, ARRAY (SELECTED)	413237	89536	413237	REF		
VR5	REFERENCE VOLTAGE SET (INCLUDES R11 & R13)	377283	89536	377283	1	1	
VR6	DIODE, ZENER, 5.6V	277236	07910	1N752A	2	1	
VR10	DIODE, ZENER, 5.6V	277236	07910	1N752A	REF		

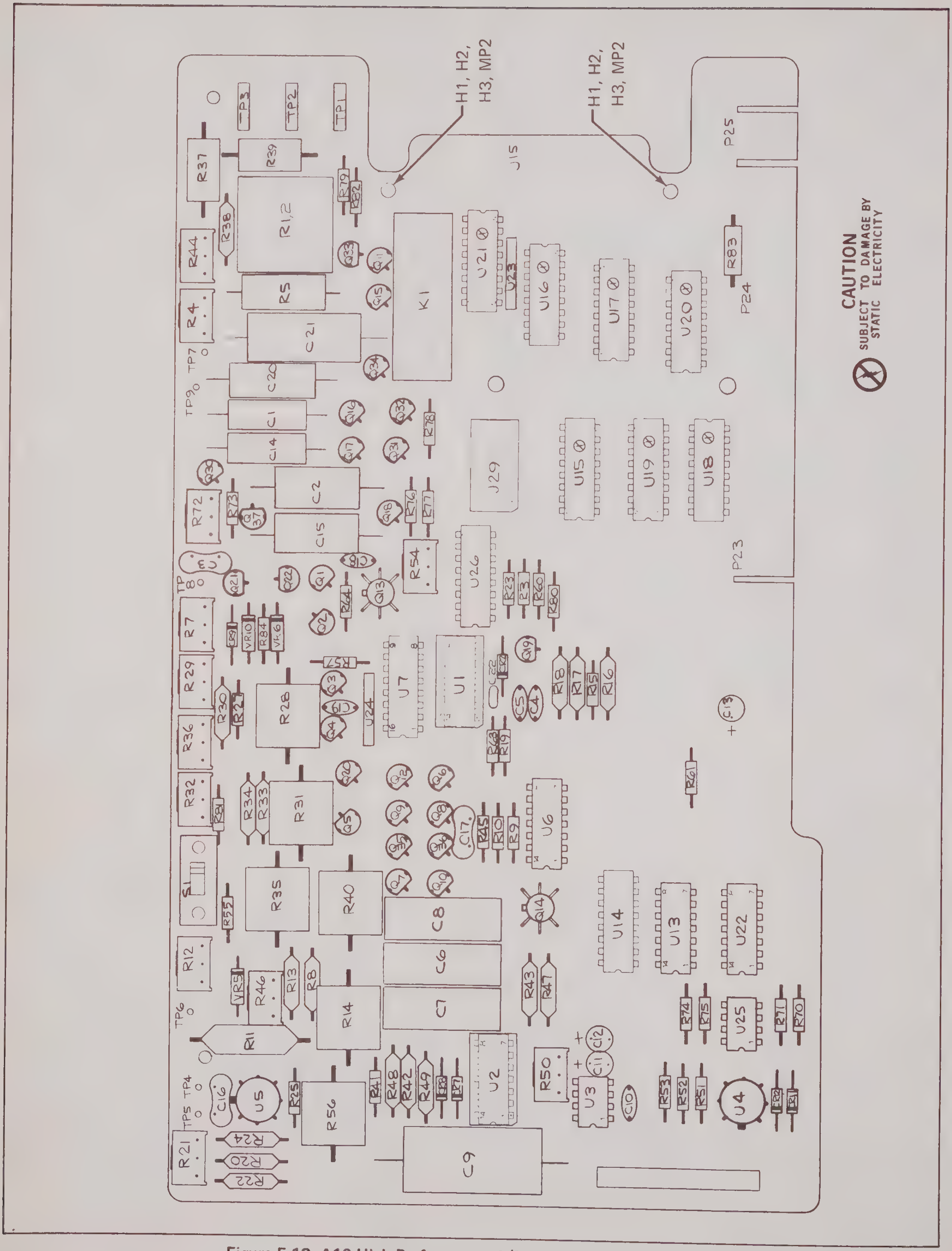

H1, H2, H3, MP2
H1, H2, H3, MP2
J15
P25
P24
P23
CAUTION SUBJECT TO DAMAGE BY STATIC ELECTRICITY
TP1
TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
R37
R39
R79
R82
R1,2
R38
R44
R5
R4
C21
C20
C1
C14
C2
C15
K1
U21
U23
U16
U17
U20
R83
J29
U15
U19
U18
R72
R73
R78
R76
R77
R54
U26
R23
R3
R60
R80
R7
R29
R36
R32
R28
R31
R35
R40
R14
R56
R12
R46
R13
R8
R11
R21
R24
R20
R22
R25
R55
R34
R33
R81
R57
R64
R84
VR10
VR6
VR5
U7
U1
U24
C22
C5
C4
C19
C18
C13
R18
R17
R15
R16
R43
R19
R61
R45
R10
R9
U6
U14
U13
U22
U25
R74
R75
R71
R70
C8
C6
C7
C9
C17
C16
C10
C11
C12
U5
U2
U3
U4
R50
R48
R42
R49
R53
R52
R51
R43
R47
S1
Q1
Q2
Q3
Q4
Q5
Q7
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q31
Q32
Q33
Q34
Q37
Q39

Figure 5-12. A10 High Performance A/D Converter PCB Assembly

Table 5-13. A11 Temperature PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	TEMPERATURE PCB ASSEMBLY FIGURE 5-13 (2200A-4021T)	409565	89536	409565	REF		
C1	CAP, MICA, 33 PF +/-5%, 500V	160317	72136	DM15E330J	1		
C2	CAP, PLASTIC, 0.47 UF +/-10%, 50V	271858	06001	75F1R5A474	1		
CR1	DIODE, SI, SWITCH	203323	07910	1N4448	3	1	
CR2	DIODE, SI, SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, SWITCH	203323	07910	1N4448	REF		
K1	REED RELAY						
	COIL	272070	71707	U-D-6-P	1		
	REED SWITCH	414300	95348	MR5830-7	2		
K2	REED RELAY						
	COIL	269019	71707	U-6-P	1		
	REED SWITCH	414300	95348	MR5830-7	1		
P29	CONNECTOR, POST	267633	00779	86144-1	14		
Q1	XSTR, SI, PNP	195974	04713	2N3906	3	1	
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	4		
R2	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R3	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
R4	RES, COMP, 2.2K +/-5%, 1/4W	148049	01121	CB2225	1		
R5	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	REF		
U1	IC, TTL, QUAD, 2-INPUT NAND GATE	393033	04713	MC74LS00P	1	1	
U2	IC, LINEAR, OP AMP	363515	12040	LM301AN	1	1	

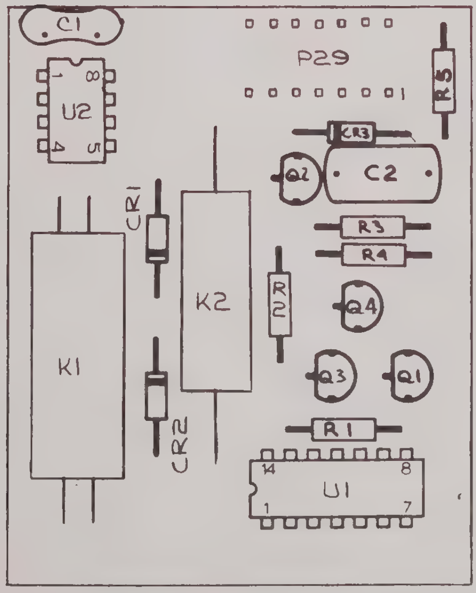


Figure 5-13. A11 Temperature PCB Assembly

Section 6

Option & Accessory Information

TABLE OF CONTENTS

ACCESSORIES

OPTION/ MODEL NO.	DESCRIPTION	DOCUMENTATION SUPPLIED:	PAGE
M07-205-600	Rack Mounting Kit	Herein	600-1
M00-280-610	Rack Slide Kit	Herein	600-1
2200A-7005	Service Extender Cable Set	Herein	600-1
2200A-7006	General Purpose Interface Cable (6 foot)	Herein	600-1
2200A-7007	Interface Connector, Blank (50 pin)	Herein	600-2
2010A-7013	Fan-Fold Printer Paper	Herein	600-2
2010A-7014	Printer Ribbon	Herein	600-2
2201A	Scanner Chassis	With 2201A	
2202A	Remote Scanner Chassis	With 2202A	
2203A	RTD Scanner Chassis	With 2203A	

OPTIONS

OPTION/ MODEL NO.	DESCRIPTION	DOCUMENTATION SUPPLIED:	PAGE
-03	RTD Connector	With Option	603-1
-05	General Purpose Scanner	With Option	605-1
-06	Low Level Scanner	With Option	606-1
-07	Solder Pin Connector	With Option	607-1
-08	Isothermal Block Connector	With Option	608-1
-12 Series	TTY/RS-232-C Interface	With Option	612-1
-13 Series	Paper Tape Punch Interface	With Option	613-1
-14 Series	Magnetic Tape Interface	With Option	614-1
-16	Digital Input Interface	With Option	616-1
-23	Alarm Set Point Output	With Option	623-1
-26	Multiple Custom Scaling	With Option	626-1
-27	Engineering Units Notation	With Option	627-1
-33	RTD Scanner	With Option	633-1
-34	Alarm Set Point	With Option	634-1

6-1. INTRODUCTION

6-2. This section of the manual contains information concerning the options and accessories available for use with the Model 2200B. It consists of an introductory section, including a table of contents, an accessories subsection and a series of option subsections. All options and accessories are listed by model or option number in the table of contents. Corresponding subsection page numbers and other documentation location information are also listed. Hardware type accessories, i.e., rack mounting kits and cables are documented in the accessories subsection. However, the more complex accessories (scanner chassis) are documented in stand-alone manuals which are provided with the purchased instrument.

6-3. The most commonly used options are documented herein as individual subsections. Each subsection contains all of the information necessary to install, operate and maintain the option. This includes a list of replaceable parts and a schematic.

6-4. The less commonly used options are also documented as subsections. However, their documentation is supplied with the purchased option and is added to Section 6 of this manual.

6-5. The location of a particular subsection is facilitated by the use of unique page and paragraph numbering which corresponds to the option or accessory in question. For example, a 600-X series identifies the general accessory subsection and a 605-X series identifies the subsection for the -05 Option (where X is the sequential page or paragraph numbers).

Accessories

600-1. RACK MOUNTING KIT (M07-205-600)

600-2. The data logger can be rack mounted in a standard 19-inch equipment rack using Rack Mounting Kit M07-205-600. Use the following procedure to install the kit:

1. Peel off the name plate decals from the front side corners of the data logger.

2. Remove the front corner screws which match the hole pattern in the rack mounting ears (see Figure 600-1).

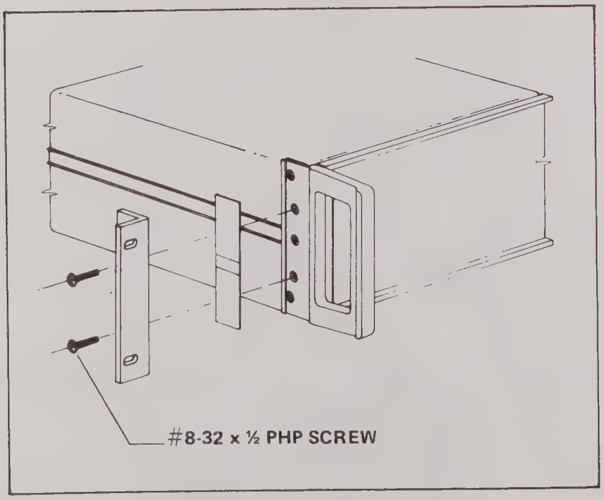


Figure 600-1. Rack Mounting Kit

3. Attach the rack mounting ears to the front corners of the unit using the screws supplied in the rack mounting kit.

600-3. RACK SLIDE KIT (M00-280-610)

600-4. The data logger can be rack mounted in a 24-inch deep equipment rack using the Rack Slide Kit M00-280-610. Use the following procedure to install the kit:

1. Remove the horizontal side trim decal from both sides of the data logger.

2. Refer to Figure 600-2 and, using the screws supplied with the kit, attach the Chassis Section (B) of the slide kit to each side of the unit. Use the center row of mounting holes.

3. Install the cabinet Section (D) of the Center Section (C) in the equipment rack.

4. Pull the Center Section of the slide out through the front of the equipment rack until it locks in the extended position.

5. Depress the spring locks on the Chassis Section (B) and joint Section B and C.

6. Push the instrument into the equipment rack and then pull it out to the extended position. The spring locks should limit the rack slide travel.

600-5. SERVICE EXTENDER CABLE SET (2200A-7005)

600-6. A set of service extender cables is available for use in servicing any one of the data logger's vertical plug-in pcb's. The majority of the pcb's require the use of only one extender. However, some of the pcb's, such as the A/D Converter, require the use of two extenders.

600-7. GENERAL PURPOSE INTERFACE CABLE (2200A-7006)

600-8. The General Purpose Interface Cable is designed for use in fabricating custom I/O cables for the Digital Input (Option -16) and the Alarm Set-Point Output (Option -23). The cable assembly consists of a 6-feet, 50-wire cable and a 50-pin connector. The connector is attached to one end of the cable and is designed to mate with the rear panel connectors on Option -16 and -23. The user is responsible for completing the connections at the free-end of cable. Refer to the appropriate Option (-16 or -23) in this section of the manual for the necessary connector pin assignments.

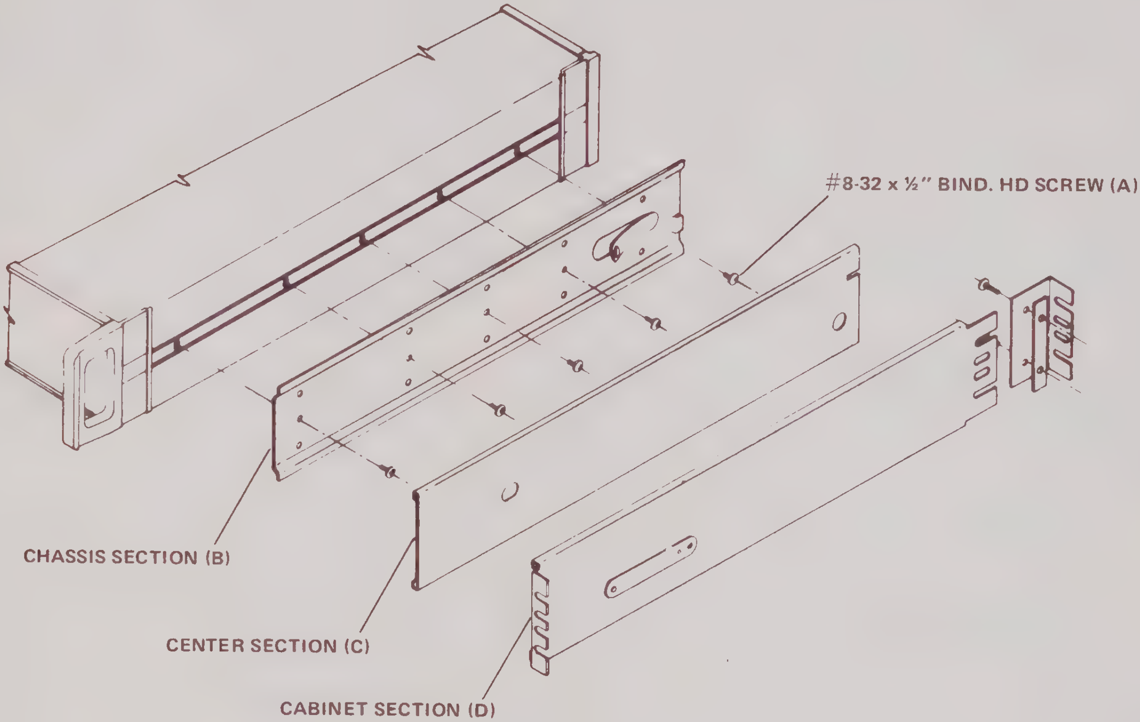


Figure 600-2. Rack Slide Kit

600-9. INTERFACE CONNECTOR (2200A-7007)

600-10. The Interface Connector is designed for use in fabricating custom I/O cables for the Digital Input Option -16 and the Alarm Set-Point Option -23. The connector assembly consists of a blank 50-pin connector and a hood. The user is responsible for the remainder of the cable. Refer to the appropriate Option (-16 or -23) in this section of the manual for the necessary connector pin assignments.

600-11. FAN-FOLD PRINTER PAPER (2010A-7013)

600-12. Fan-fold paper suitable for use with the data logger's internal printer is available from the John Fluke Mfg. Co., Inc. The paper is supplied in packages containing 1 dozen packets. Therefore, when ordering, specify model number 2010A-7013 and indicate a quantity of 1 for each dozen packets required. (See Section 2 for paper installation instructions.)

600-13. PRINTER RIBBON (2010A-7014)

600-14. Two-color (red and black) printer ribbon suitable for use with the data logger's internal printer is available from the John Fluke Mfg. Co., Inc. The ribbon is supplied in packages containing 1 dozen spools. Therefore, when ordering, specify model number 2010A-7014 and indicate a quantity of 1 for each dozen spools required. (See Section 2 for printer ribbon installation instructions.)

-03 Option
RTD Connector

603-1. INTRODUCTION

603-2. The RTD (Resistance Temperature Device) Connector (Option 2200A-03) is a card-edge connector assembly designed to function as the input connector for the 2240A-33 RTD Scanner. Four screw-type input connectors are provided for introducing either a three- or four-wire RTD input on each of 10 channels, 0 through 9. A separate common shield terminal is also available on the connnector. The shield is connected internally to the data logger's measurement guard when 1 of the 10 channels is selected for measurement.

603-3. SPECIFICATIONS

603-4. Specifications for the 2200A-03 RTD Connector are given in Table 603-1.

Table 603-1. Specifications

Compatibility:	2200/2240 series data loggers
Input Terminals:	41 screw-type connections (HI, LO, +S, −S for each of 10 channels plus common shield).

603-5. INSTALLATION

603-6. The RTD Connector can be mounted in any one of the data logger scanner-block slots which contain an RTD Scanner. Install the connector as follows:

1. Unlatch the slide fasteners located on either side of the protruding enclosure at the rear of the data logger. Remove the enclosure from the rear panel.
2. Locate the desired scanner-block slot on the rear panel and check to ensure that an RTD Scanner is installed in the slot.
3. With the connector key toward the top, position the RTD Connector in the guides of the selected slot and mate it with the scanner's connector.
4. Install the retaining screws and washers that anchor the input connector to the data logger.
5. Install the rear panel enclosure.

603-7. INPUT CONNECTIONS

603-8. Figure 603-1 identifies the screw terminals provided for attaching RTD's to the input connector. Access to the terminals is accomplished by removing the four screws from the decal side of the connector enclosure. Spaces are provided on the decal for the user to record the connector's block and channel assignments for RTD inputs. Refer to the RTD Scanner manual (Option -33) for instructions concerning three- and four-terminal RTD connections.

603-9. LIST OF REPLACEABLE PARTS

603-10. Table 603-2 contains a list of replaceable parts for the RTD Connector. Refer to Section 5 of the data logger manual for ordering information.

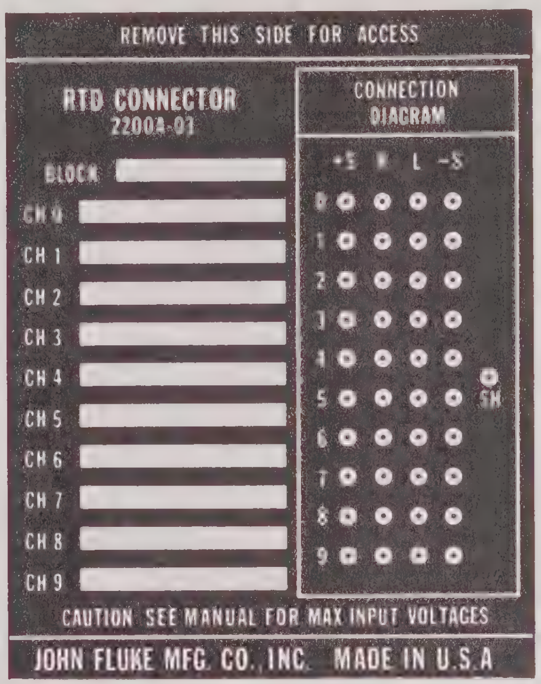

REMOVE THIS SIDE FOR ACCESS
RTD CONNECTOR
2200A-03
BLOCK
CH 0
CH 1
CH 2
CH 3
CH 4
CH 5
CH 6
CH 7
CH 8
CH 9
CONNECTION DIAGRAM
+S
H
L
-S
0
1
2
3
4
5
6
7
8
9
SH
CAUTION SEE MANUAL FOR MAX INPUT VOLTAGES
JOHN FLUKE MFG. CO., INC. MADE IN U.S.A.

Figure 603-1. RTD Connector Terminal Assignments

Table 603-2. RTD Connector Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	RTD CONNECTOR ASSEMBLY (2200A-03) FIGURE 603-2						
H1	INSERT, CONNECTOR, POLARIZING	407254	54453	ISM-K1	1		
H2	RIVET, 4 X 1/2	272493	89536	272493	2		
H3	SCREW, 6-32 X 1/4	385401	89536	385401	41		
H4	SCREW, 6-32 X 1/4	152140	89536	152140	8		
H5	SCREW, 4-40 X 7/8	335133	89536	335133	1		
H6	WASHER, FLAT	146225	89536	146225	1		
H7	WASHER, FLAT	147728	89536	147728	2		
MP1	DECAL, RTD CONNECTOR	442780	89536	442780	1		
MP2	HOUSING, RTD CONNECTOR	414276	89536	414276	2		
MP3	TAPE, FOAM	424127	89536	424127	2		
P13	CONNECTOR, CARD-EDGE, 44-PIN	385674	89536	385674	1		

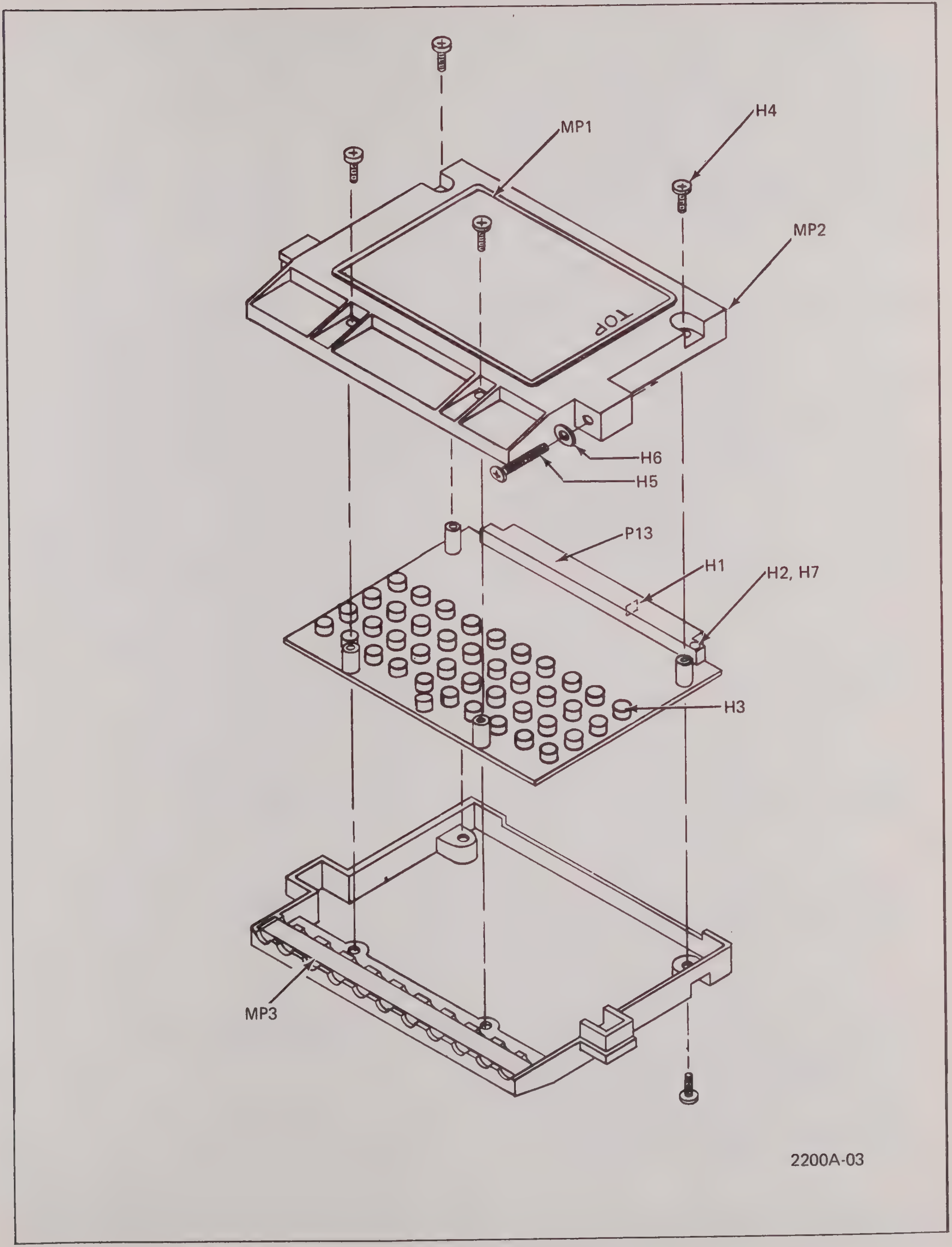

MP1
H4
MP2
TOP
H6
H5
P13
H1
H2, H7
H3
MP3
2200A-03

Figure 603-2. RTD Connector Assembly

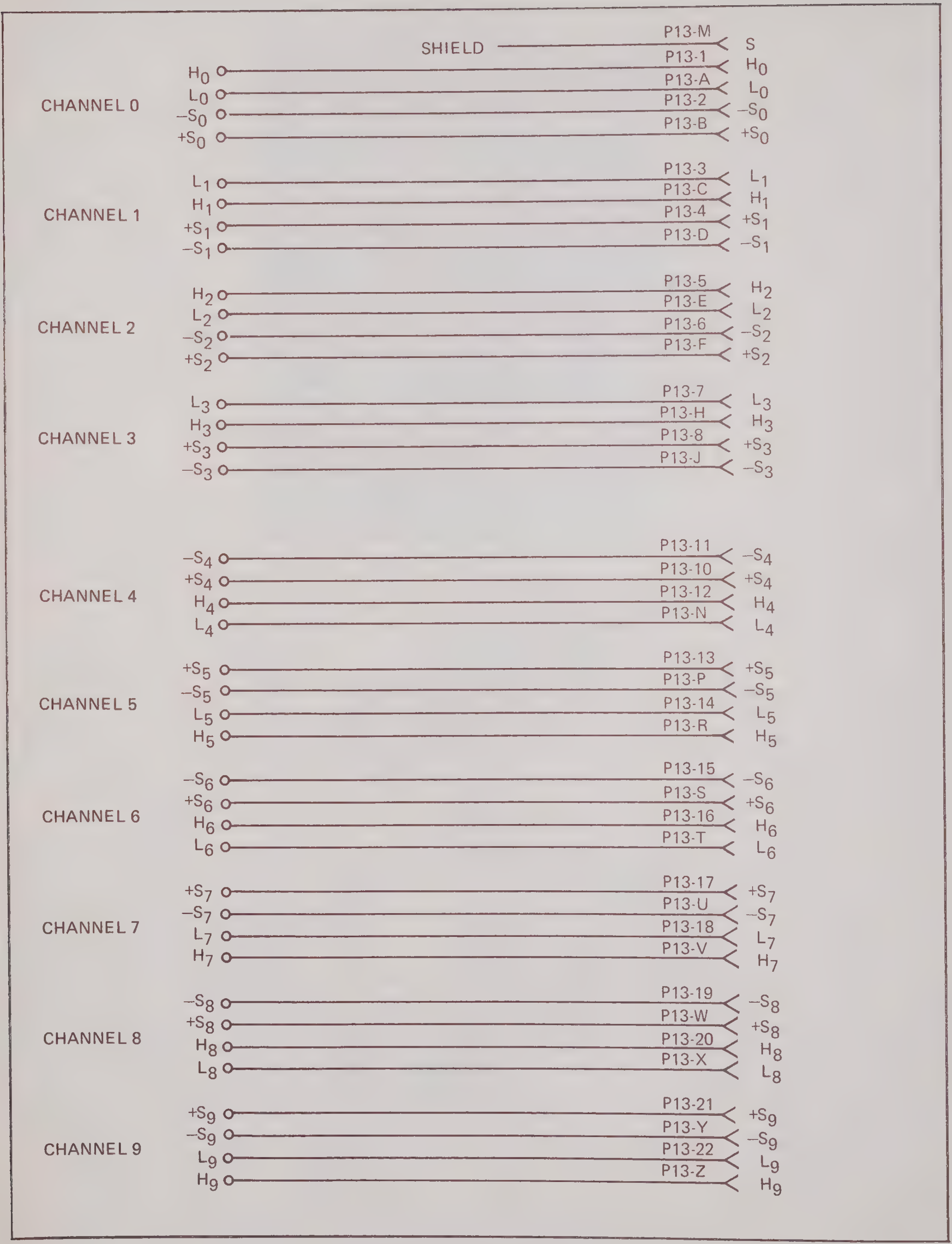

SHIELD
P13-M
S
CHANNEL 0
H_0 P13-1 H_0
L_0 P13-A L_0
$-S_0$ P13-2 $-S_0$
$+S_0$ P13-B $+S_0$
CHANNEL 1
L_1 P13-3 L_1
H_1 P13-C H_1
$+S_1$ P13-4 $+S_1$
$-S_1$ P13-D $-S_1$
CHANNEL 2
H_2 P13-5 H_2
L_2 P13-E L_2
$-S_2$ P13-6 $-S_2$
$+S_2$ P13-F $+S_2$
CHANNEL 3
L_3 P13-7 L_3
H_3 P13-H H_3
$+S_3$ P13-8 $+S_3$
$-S_3$ P13-J $-S_3$
CHANNEL 4
$-S_4$ P13-11 $-S_4$
$+S_4$ P13-10 $+S_4$
H_4 P13-12 H_4
L_4 P13-N L_4
CHANNEL 5
$+S_5$ P13-13 $+S_5$
$-S_5$ P13-P $-S_5$
L_5 P13-14 L_5
H_5 P13-R H_5
CHANNEL 6
$-S_6$ P13-15 $-S_6$
$+S_6$ P13-S $+S_6$
H_6 P13-16 H_6
L_6 P13-T L_6
CHANNEL 7
$+S_7$ P13-17 $+S_7$
$-S_7$ P13-U $-S_7$
L_7 P13-18 L_7
H_7 P13-V H_7
CHANNEL 8
$-S_8$ P13-19 $-S_8$
$+S_8$ P13-W $+S_8$
H_8 P13-20 H_8
L_8 P13-X L_8
CHANNEL 9
$+S_9$ P13-21 $+S_9$
$-S_9$ P13-Y $-S_9$
L_9 P13-22 L_9
H_9 P13-Z H_9

Figure 603-2. RTD Connector Assembly (cont)

Option -05
General Purpose Scanner

605-1. INTRODUCTION

605-2. The General Purpose Scanner (Option -05) is a plug-in, 10-channel, 2-wire relay scanner designed to operate as a general purpose, analog data multiplexer in a 2200 series data logger/scanner chassis (hereafter referred to collectively as data logger). Switched high and low inputs are provided for each of the 10 channels and a common (unswitched) shield is provided for all 10 channels. A decoupling relay is used to isolate the high, low and shield buses from the common output connections when a channel relay is not activated. Activating any one of the 10 channel relays also energizes the decoupling relay.

605-3. SPECIFICATIONS

605-4. Specifications for the General Purpose Scanner are given in Table 605-1.

Table 605-1. Option -05 Specifications

Channel Relays	10 low thermal-emf reed relays
Poles Per Channel . . .	Two (form A)
Shield Switching	One switch for 10 channels
Voltage Offset	⩽10 μV
Input Voltage Limit* . .	170V dc or peak ac max
Common Mode Voltage Limit (Voltage between chassis and any input) .	350V dc or peak ac max provided the Input Voltage Limit is not exceeded

**Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.*

605-5. INSTALLATION

605-6. The General Purpose Scanner mounts in any one of the available scanner-block slots provided in the data logger, as shown Figure 605-1. Install the scanner as follows:

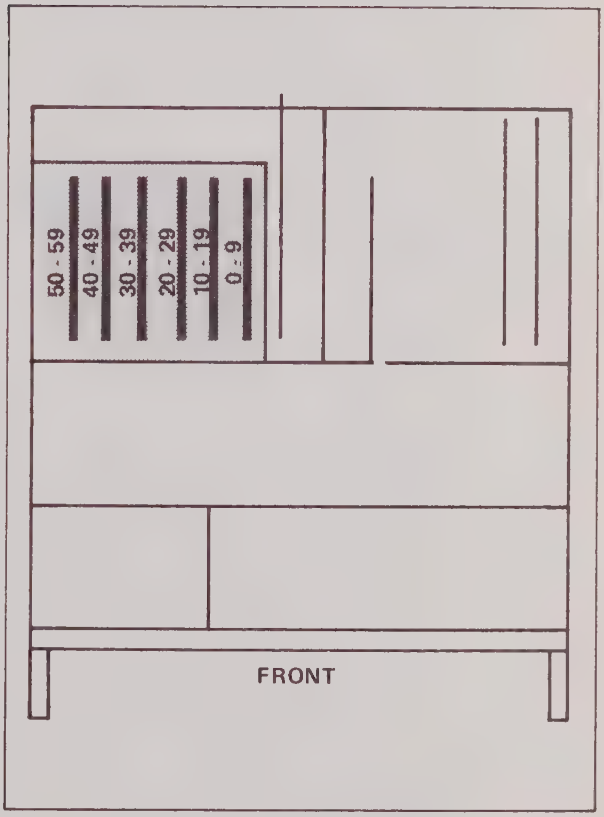


Figure 605-1. Scanner Mounting Locations

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

1. Remove the top dust cover from the data logger.

2. Remove the large top inner cover located in the left rear of the unit (as viewed from the top front).

CAUTION

Handle the Scanner PCB by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

3. Select the slot that includes the block of channels the scanner is to represent, and align the scanner in the slot so that the large board-edge connector is toward the rear of the unit, and the small offset board-edge connectors are toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

4. After the desired number of scanners are installed, install the large left rear inner cover.

5. Install the top dust cover.

605-7. OPERATION

605-8. Once installed in the data logger, the General Purpose Scanner requires no operator attention. However, certain considerations are necessay to properly interface the scanner with analog input data. These considerations are covered in the following paragraphs.

605-9. Input Connections

605-10. Analog interface connections with the General Purpose Scanner are completed through either one-of-two types of connectors, both of which are available as options. They include the Solder Pin Connector (Option -07) and the Isothermal Block Connector (Option -08). The Solder Pin Connector is a general purpose assembly which consists of a 44-pin connector with solder-type cable connections. A clam-shell housing provides strain relief for the cable, and protection of the connector contacts. The Isothermal Block Connector is required for the thermocouple inputs. It features an Isothermal Block with screw-type connections, and a temperature sensing circuit. Refer to the appropriate option subsection for additional information.

605-11. Input Pin Assignments

605-12. The pin assignments for the rear panel connector of the General Purpose Scanner are shown in Figure 605-2. Since contact with these signals is completed through one-of-two connector assemblies (Option -07 or -08) refer to the appropriate option subsection for pin assignments as available for fabricating interface cables.

NOTE

The Guard connections shown in Figure 605-2 represent a unique potential within the data logger. Input shields should be connected to the Shield (pin 2), not to the Guards.

TOP

L0	A	1	H0
GUARD	B	2	SHIELD
H1	C	3	L1
—	D	4	GUARD
L2	E	5	H2
GUARD	F	6	—
H3	H	7	L3
—	J	8	A/D COM.
TEMP. SIG.	K	9	6.2V dc (OUT)
BSL	L	10	REF. COM.
GUARD	M	11	—
L4	N	12	H4
—	P	13	GUARD
H5	R	14	L5
GUARD	S	15	—
L6	T	16	H6
—	U	17	GUARD
H7	V	18	L7
GUARD	W	19	—
L8	X	20	H8
—	Y	21	GUARD
H9	Z	22	L9

Lx = Low input to channel x.
Hx = High input to channel x.
Where: x = Block channel No. (0 - 9)
— = Not Used

Figure 605-2. General Purpose Scanner Rear Panel Pin Assignments

605-13. THEORY OF OPERATION

605-14. The General Purpose Scanner, as shown in Figure 605-3, is a programmable, 10-channel relay scanner designed to operate as a plug-in option in any on of the scanner-block slots in a 2200 series Data Logger. Channel scanning or multiplexing is accomplished by a series of 12 form-A reed relays; 11 double pole and 1 single pole. Ten of the double-pole relays serve as two-wire input channel switches to a common high/low output bus. The eleventh two-pole relay also contacts the two-wire bus. However, its function is to isolate or decouple the scanner bus from the actual output connections. When any one of the channel relays is energized the decoupling relay is also activated to complete the two-wire input/output circuit. The single-pole relay operates in parallel with the decoupling relay. When closed, it connects a common channel-input shield to the output shield connection. Thus, the scanner actually provides a three-wire output (high, low and shield).

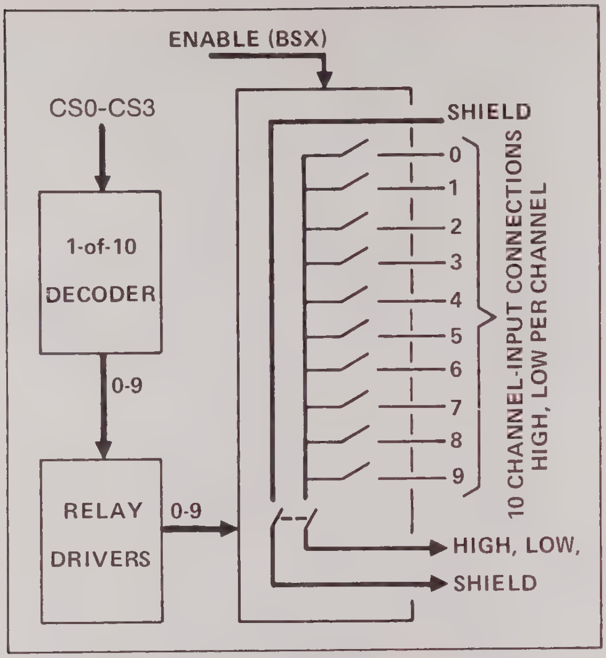

ENABLE (BSX)
CS0-CS3
1-of-10
DECODER
0-9
RELAY
DRIVERS
0-9
SHIELD
0
1
2
3
4
5
6
7
8
9
10 CHANNEL-INPUT CONNECTIONS
HIGH, LOW PER CHANNEL
HIGH, LOW,
SHIELD

Figure 605-3. General Purpose Scanner, Functional Block Diagram

605-15. All scanner pcb's installed in a data logger receive bcd channel select information from a single data bus (CS0 through CS3). This data is decoded on each scanner pcb into 10 separate channel commands (0-9). Each channel line is first buffered and then connected to one of the 10 channel relay coils Even though these commands are present, the relays will not be energized unless the scanner receives a scanner-block select (BSX) command. This command is actually an address or enable signal which applies voltage to the low side of the relay's coils. When the coil voltage is present the decoupling relay, the shield relay and the selected channel relay will be energized. At that time the analog input data on the selected channel appears at the scanner output terminals.

605-16. MAINTENANCE

605-17. Access Information

605-18. Refer to the installation information given in paragraph 605-6 for scanner access information. Remove the rear panel input connector before attempting to remove the scanner pcb from the data logger.

605-19. Performance Test

605-20. The performance test is designed to verify the overall operation of the General Purpose Scanner PCB Assembly and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 605-2. If the scanner fails any part of the performance test corrective action is required.

Table 605-2. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
Data Logger	Fluke 2200B/2240B
Input Connector	Fluke 2200A–07 or –08
Resistors (10 each)	Metal film, 1k ±1%, 1/4W

1. Using the resistors and the input connector specified in Table 605-2, fabricate a scanner test cable as shown in Figure 605-4.

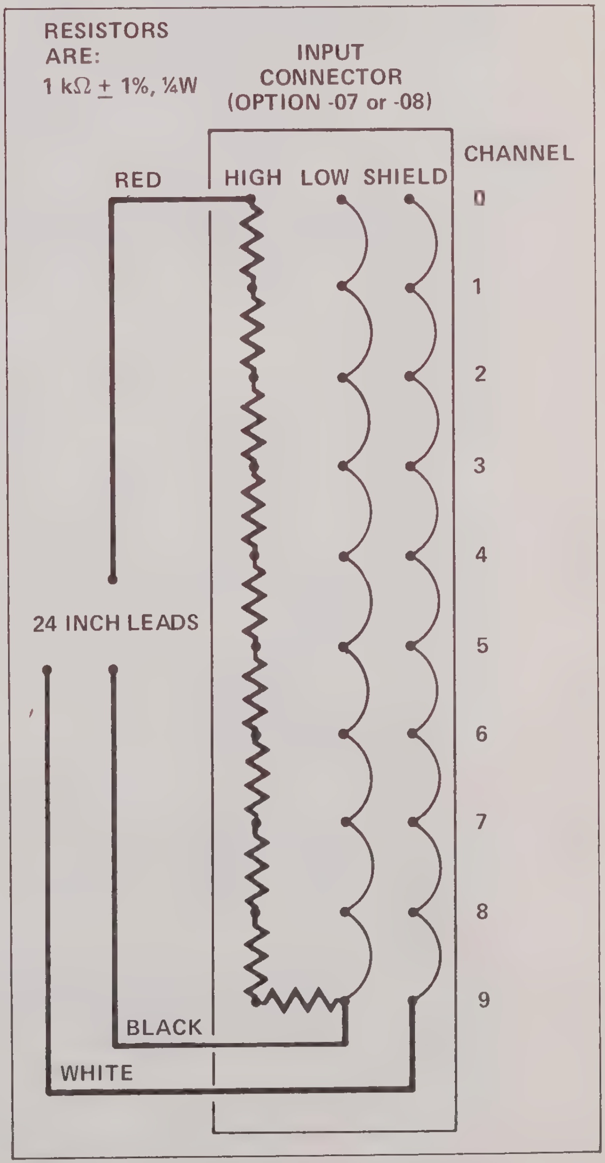

RESISTORS
ARE:
1 kΩ ± 1%, ¼W
INPUT
CONNECTOR
(OPTION -07 or -08)
CHANNEL
RED
HIGH
LOW
SHIELD
0
1
2
3
4
5
6
7
8
9
24 INCH LEADS
BLACK
WHITE

Figure 605-4. Scanner Test Cable

2. Install the Low Level Scanner PCB in the channel 0-9 slot of the data logger.

3. Set the calibrator output to 0V dc.

4. Connect the test cable leads to the calibrator's voltage output terminals (red to positive, black and white to negative).

5. Set the calibrator output to 1.000V dc.

6. Program the data logger as follows:

   a. First channel to 0.

   b. Last channel to 9.

   c. Each channel function to 4V.

   d. Press the ALL DATA (printer) switch in the OUTPUT CONTROL switch group.

7. Press the SINGLE scan switch and observe the printer measurement data. Channel 0 should read +1.000V dc ±1%. A cumulative +0.1V dc decrease should be observed at each of the remaining channels. (Channel 9 should read +0.1V dc.) Any deviation in this pattern indicates a defective pcb assembly.

605-21. LIST OF REPLACEABLE PARTS

605-22. A list of replaceable parts for the General Purpose Scanner PCB Assembly is given in Table 605-3. Refer to Section 5 of this manual for ordering information.

CAUTION

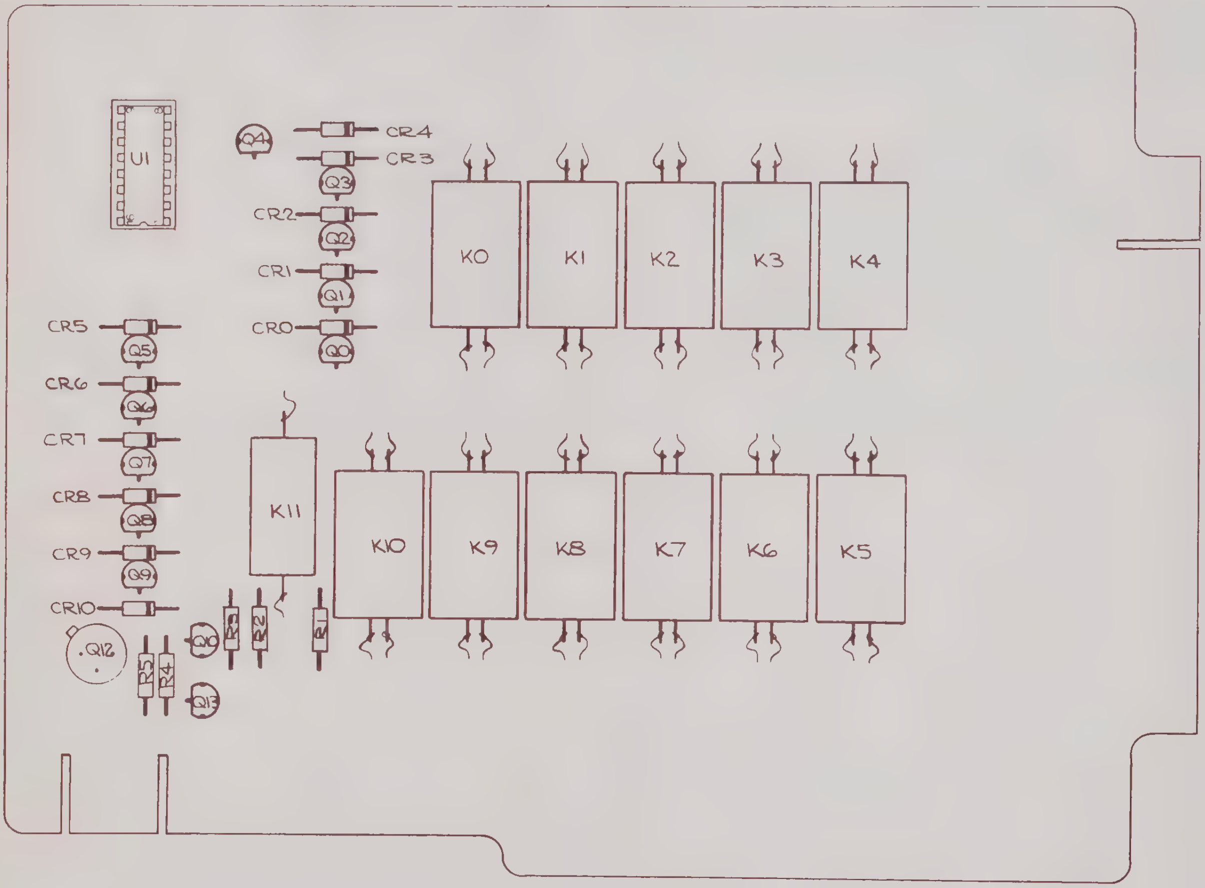
Indicated devices are subject to damage by static discharge.

Table 605-3. General Purpose Scanner PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	GENERAL PURPOSE SCANNER PCB ASSY, OPT-05 FIGURE 605-5 (2200A-4006)	ORDER	OPT.	-05			
CR0	DIODE, SI	203323	07910	1N4448	11	2	
CR1	DIODE, SI	203323	07910	1N4448	REF		
CR2	DIODE, SI	203323	07910	1N4448	REF		
CR3	DIODE, SI	203323	07910	1N4448	REF		
CR4	DIODE, SI	203323	07910	1N4448	REF		
CR5	DIODE, SI	203323	07910	1N4448	REF		
CR6	DIODE, SI	203323	07910	1N4448	REF		
CR7	DIODE, SI	203323	07910	1N4448	REF		
CR8	DIODE, SI	203323	07910	1N4448	REF		
CR9	DIODE, SI	203323	07910	1N4448	REF		
CR10	DIODE, SI	203323	07910	1N4448	REF		
K0	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	11		
K1	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K2	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K3	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K4	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K5	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K6	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K7	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K8	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K9	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K10	RELAY, DRY REED, DPST	442921	21317	052A5300BAA	REF		
K11	RELAY ASSEMBLY						
	COIL	269019	71707	U-6-P	1		
	SWITCH, REED	414300	95348	MR5830-7	1		
MP1	COVER, SCANNER, PROTECTIVE (NOT SHOWN)	371542	89536	371542	1		
MP2	SPACER, TRANSIPAD (NOT SHOWN)	152207	07047	10123-DAP	1		
Q0	XSTR, SI, PNP	195974	04713	2N3906	10	2	

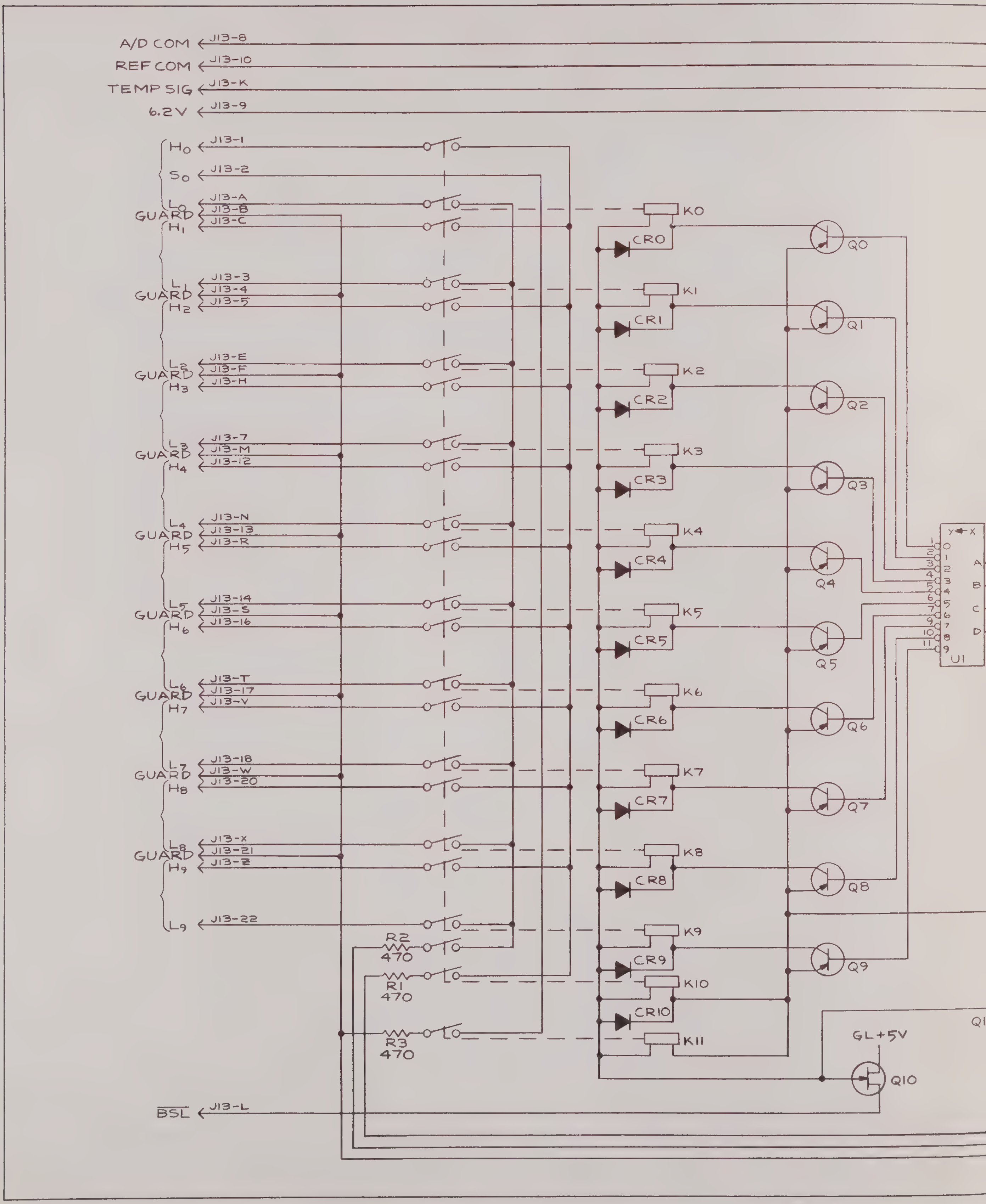
Table 605-3. General Purpose Scanner PCB Assembly (cont)

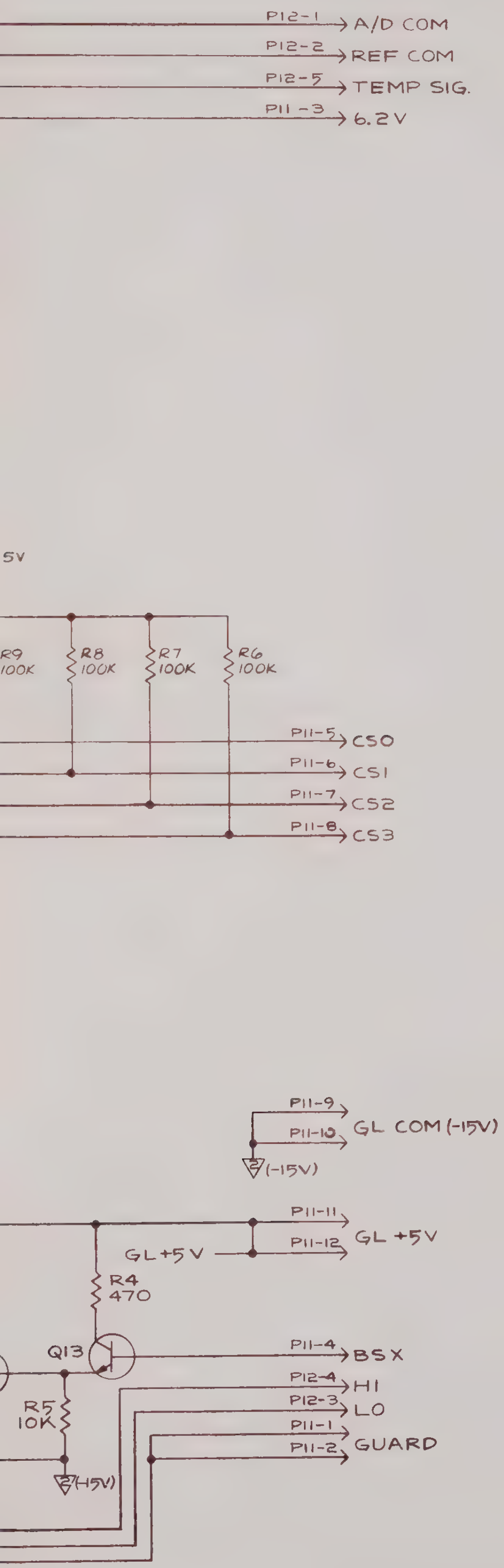
ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q1	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q10	XSTR, J-FET, N-CHANNEL	352112	07910	U26106	1	1	
Q12	XSTR, SI, NPN	182196	07263	2N3643	1	1	
Q13	XSTR, SI, NPN	218396	04713	2N3904	1	1	
R1	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	4		
R2	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R3	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R4	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R5	RES, COMP, 10K +/-5%, 1/4W	148106	01121	CB1035	1		
R6	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	4		
R7	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R8	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
R9	RES, COMP, 100K +/-5%, 1/4W	148189	01121	CB1045	REF		
U1	IC, MOS, 1-OF-10 DECODER	407981	12040	MM74C42N	1	1	
UX1	SOCKET, IC, 16-PIN DIP	276535	91506	316AG39D	1		


U1
Q4
CR4
CR3
Q3
CR2
Q2
CR1
Q1
CR0
Q0
CR5
Q5
CR6
Q6
CR7
Q7
CR8
Q8
CR9
Q9
CR10
Q12
R5
R4
Q10
R3
R2
R1
Q13
K0
K1
K2
K3
K4
K11
K10
K9
K8
K7
K6
K5

2200A-1606

Figure 605-5. General Purpose Scanner PCB Assembly


A/D COM
J13-8
REF COM
J13-10
TEMP SIG
J13-K
6.2V
J13-9
H0
J13-1
S0
J13-2
L0
J13-A
GUARD
J13-B
H1
J13-C
L1
J13-3
GUARD
J13-4
H2
J13-5
L2
J13-E
GUARD
J13-F
H3
J13-H
L3
J13-7
GUARD
J13-M
H4
J13-12
L4
J13-N
GUARD
J13-13
H5
J13-R
L5
J13-14
GUARD
J13-S
H6
J13-16
L6
J13-T
GUARD
J13-17
H7
J13-V
L7
J13-18
GUARD
J13-W
H8
J13-20
L8
J13-X
GUARD
J13-21
H9
J13-Z
L9
J13-22
R2
470
R1
470
R3
470
K0
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
K11
CR0
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q1
GL+5V
U1
Y
X
A
B
C
D
1
2
3
4
5
6
7
8
9
10
11
0
1
2
3
4
5
6
7
8
9
$\overline{BSL}$
J13-L


P12-1
A/D COM
P12-2
REF COM
P12-5
TEMP SIG.
P11-3
6.2 V
5V
R9
100K
R8
100K
R7
100K
R6
100K
P11-5
CS0
P11-6
CS1
P11-7
CS2
P11-8
CS3
P11-9
P11-10
GL COM (-15V)
(-15V)
P11-11
P11-12
GL +5V
GL+5V
R4
470
Q13
P11-4
BSX
R5
10K
P12-4
HI
P12-3
LO
P11-1
P11-2
GUARD
(+5V)

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM(-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. ALL VOLTAGES NOTED ARE WITH RESPECT TO A/D COM.

I.C. REF. DES.	PIN NO.	
	GL+5V	GL COM
U1	16	8

2200A-1006

Figure 605-5. General Purpose Scanner PCB Assembly (cont)

Option -06
Low Level Scanner

606-1. INTRODUCTION

606-2. The Low Level Scanner (Option -06) is a plug-in, 10-channel, 3-wire relay scanner designed to operate as a low-level, analog data multiplexer in a 2200 series data logger/scanner chassis (hereafter referred to collectively as data logger). Switched high, low and shield inputs are provided for each of the 10 channels. A decoupling relay is used to isolate the high, low and shield buses from the common output connections when a channel relay is not activated. Activating any one of the 10-channel relays also energizes the decoupling relay.

606-3. SPECIFICATIONS

606-4. Specifications for the Low Level Scanner are contained in Table 606-1.

Table 606-1. Option -06 Specifications

Channel Relays	10 low thermal-emf reed relays
Poles per Channel	Three (includes shield switch)
Shield Switching	One switch per channel
Voltage Offset	$\leqslant 1\ \mu V$
Input Voltage Limit*	170V dc or peak ac max
Common Mode Voltage Limits (Voltage between chassis and any input)	350V dc or peak ac provided the Input Voltage Limit is not exceeded
Over-Current Protection	470Ω resistor in series with each input

**Maximum voltage between any two terminals in the system. Includes normal mode as well as common mode voltages.*

606-5. INSTALLATION

606-6. The Low Level Scanner mounts in any one of the available scanner block slots provided in the data logger, as shown in Figure 606-1. Install the scanner as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

1. Remove the top dust cover from the data logger.

2. Remove the large top inner cover located in the left rear of the unit (as viewed from the top front).

CAUTION

Handle the scanner pcb by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

3. Select the slot that includes the block of channels the scanner is to represent, and align the scanner in the slot so that the 44-pin board-edge connector is toward the rear of the unit, and the small offset board-edge connectors are toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

4. After the desired number of scanners are installed, install the large left rear inner cover.

5. Install the top dust cover.

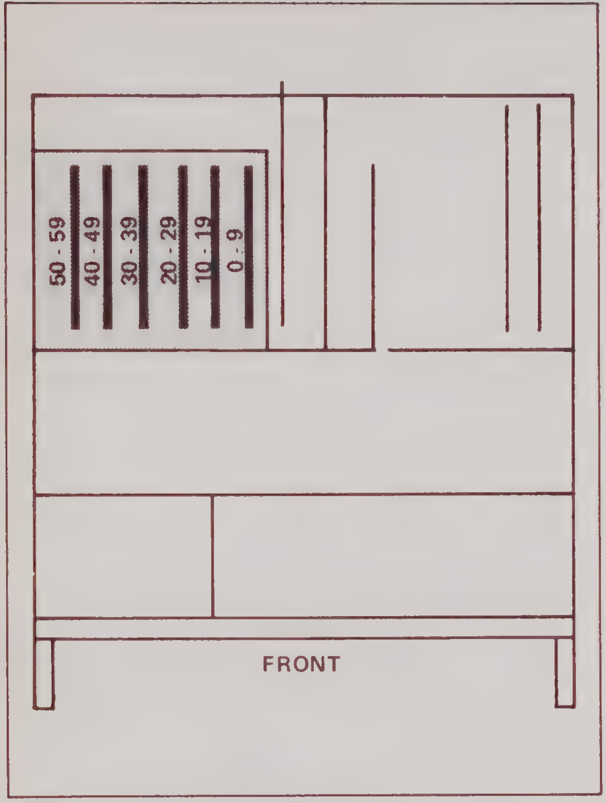


Figure 606-1. Scanner Mounting Locations

606-7. OPERATION

606-8. Once installed in the data logger, the Low Level Scanner requires no operator attention. However, certain considerations are necessary to properly interface the scanner with analog input data. These considerations are covered in the following paragraphs.

606-9. Input Connections

606-10. Analog interface connections with the Low Level Scanner are completed through either one-of-two types of connectors, both of which are available as options. They include the Solder Pin Connector (Option -07) and the Isothermal Block Connector (Option -08). The Solder Pin Connector is a general purpose assembly which consists of a 44-pin connector mounted on a pcb. Solder type cable connections are provided. A clam-shell housing provides strain relief for the cable, and protection of the connector contacts. The Isothermal Block Connector is required for thermocouple inputs. It features an Isothermal block with screw-type connections, and a temperature sensing circuit. Refer to the appropriate option subsection for additional information.

606-11. Input Pin Assignments

606-12. The pin assignments for the rear panel connector of the Low Level Scanner are shown in Figure 606-2. Since contact with these signals is completed through one-of-two optional connectors (Option -07 or -08) refer to the appropriate option subsection for pin assignments as available for fabricating interface cables.

NOTE

The Guard connections shown in Figure 606-2 represent a unique potential within the data logger. Input shields should be connected to the Shield pins, not to the Guard pins.

TOP

L0	A	1	H0
GUARD	B	2	S0
H1	C	3	L1
S1	D	4	GUARD
L2	E	5	H2
GUARD	F	6	S2
H3	H	7	L3
S3	J	8	A/D COM.
TEMP. SIG.	K	9	6.2V dc (OUT)
BSL	L	10	REF. COM.
GUARD	M	11	S4
L4	N	12	H4
S5	P	13	GUARD
H5	R	14	L5
GUARD	S	15	S6
L6	T	16	H6
S7	U	17	GUARD
H7	V	18	L7
GUARD	W	19	S8
L8	X	20	H8
S9	Y	21	GUARD
H9	Z	22	L9

Sx = Shield for channel x.
Lx = Low input to channel x.
Hx = High input to channel x.
Where:x = Block channel no. (0-9)

Figure 606-2. Low Level Scanner Rear Panel Pin Assignments

606-13. THEORY OF OPERATION

606-14. The Low Level Scanner, as shown in Figure 606-3, is a programmable, 10-channel relay scanner designed to operate as a plug-in option in any one of the scanner block slots in a 2200 series Data Logger. Channel scanning or multiplexing is accomplished by a series of 11 three-pole, form-A, reed relays. Ten of the relays serve as three-wire input-channel switches to a common (high/low/shield) output bus. The eleventh relay also contacts the three-wire bus. However, its function is to isolate or decouple the scanner bus from the actual output connections. When any one of the channel relays is energized the decoupling relay is also activated to complete the three-wire input/output circuit.

606-15. All scanner pcb's installed in a data logger receive bcd channel select information in parallel from a four-bit data bus (CS0 through CS3). This data is decoded on each scanner pcb into 10 separate channel commands (0-9). Each command line is first buffered and then connected to one of the 10 channel-relay coils. Even though these commands are present, the relays will not be energized unless the scanner receives a scanner-block select (BSX) command. This command is actually an address or enable signal which applies a control command to the low side of the relay coils. When this signal is present the decoupling relay and the selected channel relay will be energized. At that time the analog input data on the selected channel appears at the scanner output terminals.

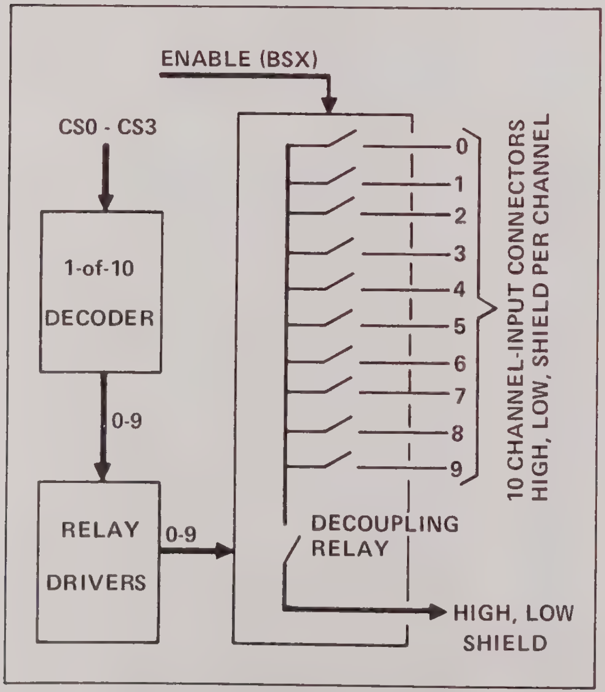


Figure 606-3. Low Level Scanner, Functional Block Diagram

606-16. MAINTENANCE

606-17. Access Information

606-18. Refer to the installation information given in paragraph 606-6 for scanner access information. Remove the rear panel input connector before attempting to remove the scanner pcb from the data logger.

606-19. Performance Test

606-20. The performance test is designed to verify the overall operation of the Low Level Scanner PCB Assembly, and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 606-2. If the scanner fails any part of the performance test, corrective action is required.

1. Using the resistors and the input connector specified in Table 606-2, fabricate a scanner test cable as shown in Figure 606-4.

2. Install the Low Level Scanner PCB in the channel 0-9 slot of the data logger.

3. Set the calibrator output to 0V dc.

4. Connect the test cable leads to the calibrator's voltage output terminals (red to positive, black and white to negative).

5. Set the calibrator output to 1.000V dc.

6. Program the data logger as follows:

   a. First channel to 0.

   b. Last channel to 9.

   c. Each channel function to 4V.

   d. Press the ALL DATA (printer) switch in the OUTPUT CONTROL switch group.

7. Press the SINGLE scan switch and observe the printed measurement data. Channel 0 should read +1.000V dc ±1%. A cumulative +0.1V dc decrease should be observed at each of the remaining channels. (Channel 9 should read +0.1V dc.) Any deviation in this pattern indicates a defective pcb assembly.

Table 606-2. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
DC Voltage Calibrator	Fluke 343A
Data Logger	Fluke 2200B/2240B
Input Connector	Fluke 2200A–07 or –08
Resistors (10 each)	Metal film 1k ±1%, 1/4W

606-21. LIST OF REPLACEABLE PARTS

606-22. A list of replaceable parts for the Low Level Scanner PCB Assembly is given in Table 606-3. Refer to Section 5 of this manual for ordering information.

CAUTION

⊗

Indicated devices are subject to damage by static discharge.

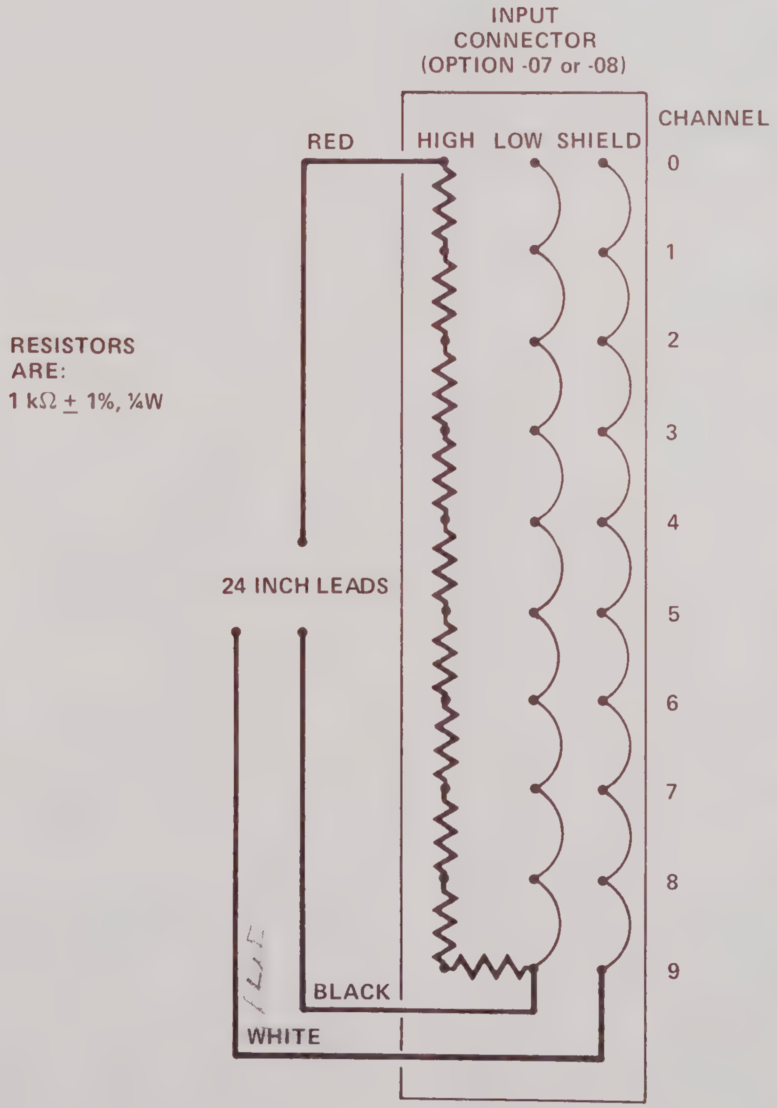

INPUT
CONNECTOR
(OPTION -07 or -08)
CHANNEL
RED
HIGH
LOW
SHIELD
0
1
2
3
4
5
6
7
8
9
RESISTORS ARE:
1 kΩ ± 1%, ¼W
24 INCH LEADS
BLACK
WHITE

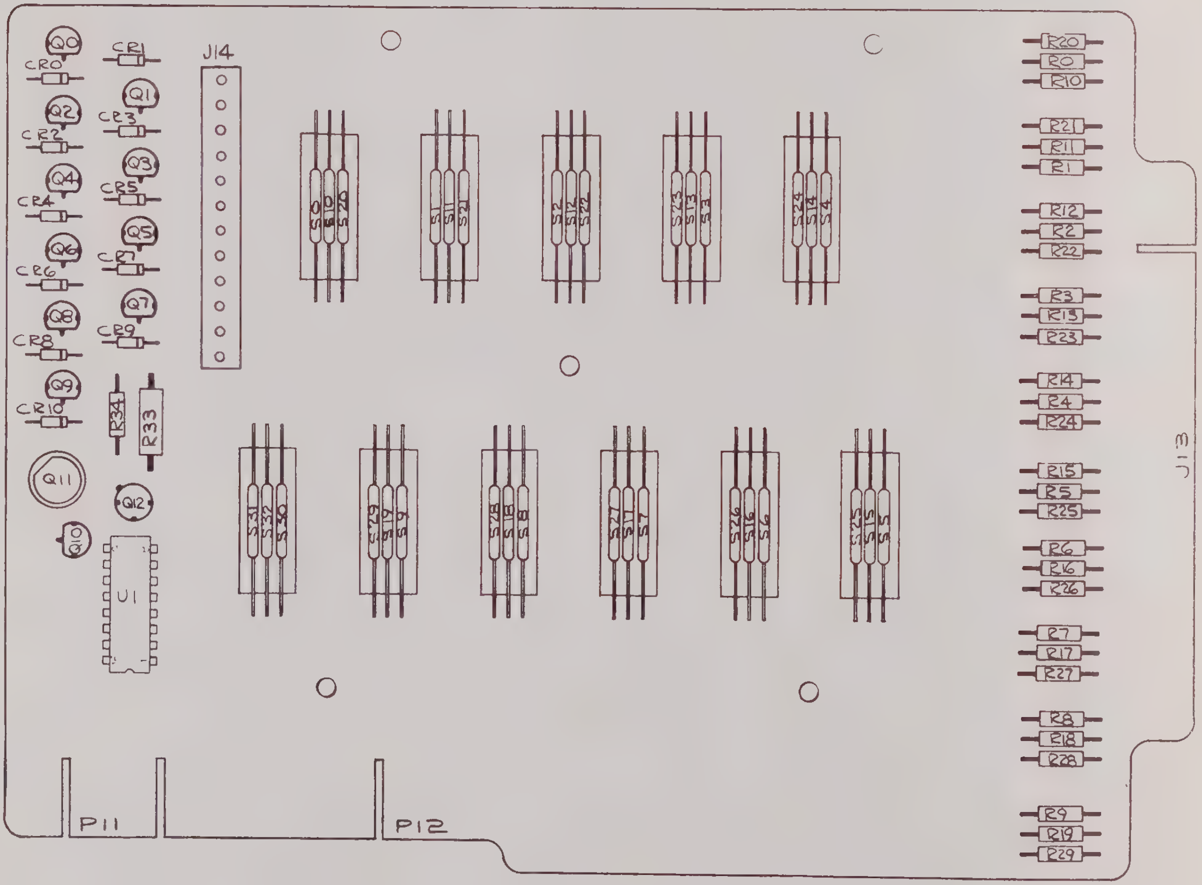
Figure 606-4. Scanner Test Cable

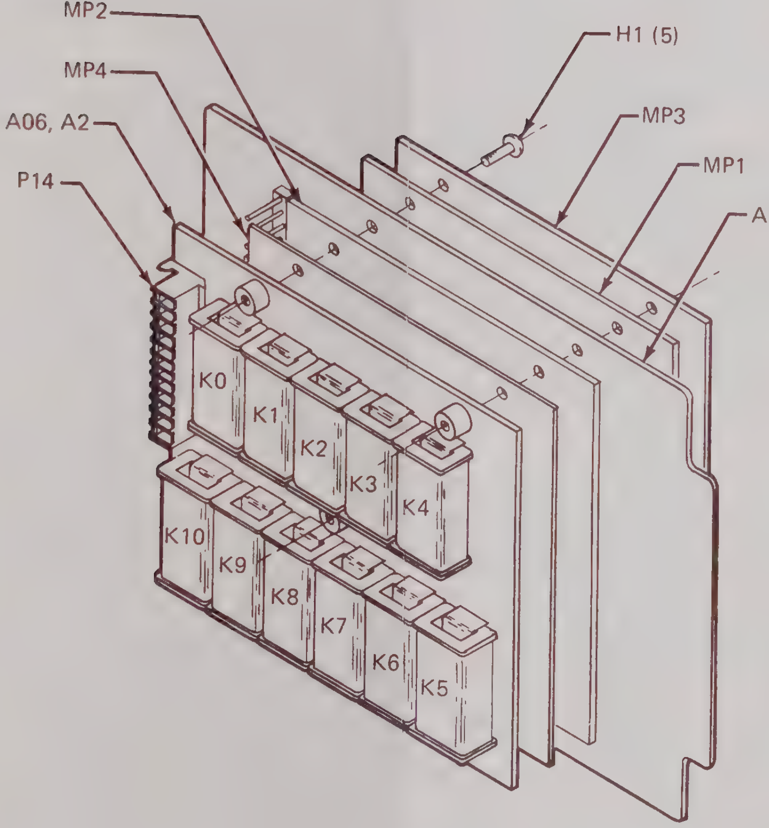
Table 606-3. Low Level Scanner PCB Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	⊘ LOW LEVEL SCANNER ASSEMBLY, OPTION -06 FIGURE 606-5 (2200A-4024)	OPT-06	89536	ORDER BY OPTION -06			
CR0	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	11	3	
CR1	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR10	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
H1	SCREW, PHP, 6-35 X 5/8	152181	73734	19047	5		
J14	CONNECTOR, MALE, 12-PIN	380683	27264	A2402-09-64-1121	1		
K0-K10	RELAY COIL ASSY.						
	COIL, REED RELAY, 135 +/-10%, 5V	380709	71707	E8206	11		
	CORE, METAL, RELAY-COIL	380451	89536	380451	11		
MP1	SHIELD, BOTTOM SCANNER	412296	89536	412296	1		
MP2	SHIELD, TOP SCANNER	412304	89536	412304	1		
MP3	SPACER, BOTTOM	412320	89536	412320	1		
MP4	SPACER, TOP	412312	89536	412312	1		
P14	CONNECTOR, FEMALE, 12-PIN	380691	27264	2145-B09-52-3122	1		
Q0	XSTR, SI, PNP	195974	04713	2N3906	10	2	
Q1	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q2	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q3	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q4	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q5	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q6	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q7	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q10	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q11	XSTR, SI, NPN	182196	07263	2N3643	1	1	
Q12	XSTR, FET, N-CHANNEL	357905	89536	357905	1	1	
R0	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	31		
R1	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R2	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R3	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R4	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R5	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R6	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R7	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R8	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R9	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R10	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R11	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R12	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R13	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R14	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		

Table 606-3. Low Level Scanner PCB Assembly (cont)

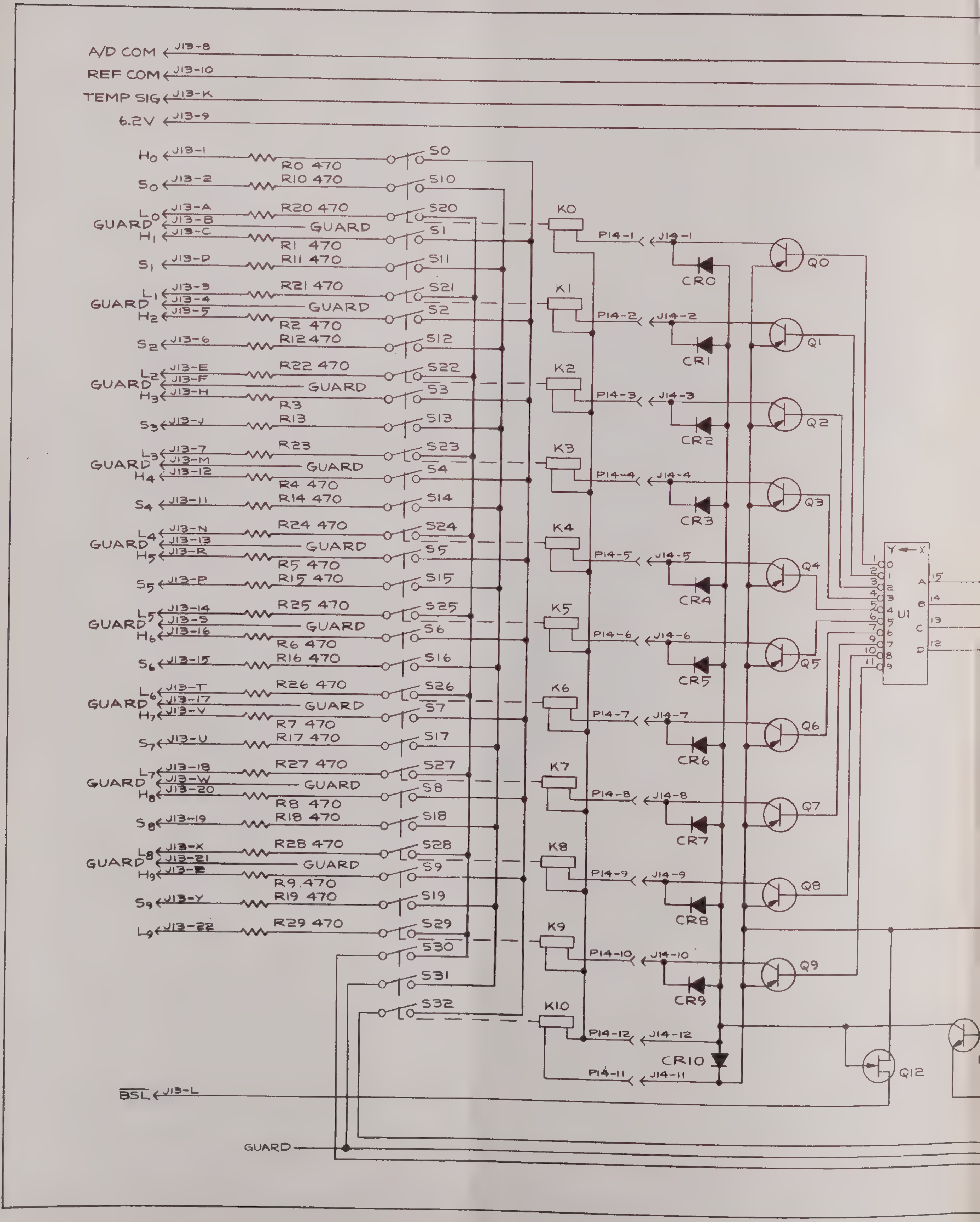
ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R15	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R16	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R17	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R18	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R19	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R20	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R21	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R22	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R23	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R24	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R25	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R26	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R27	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R28	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R29	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
R33	RES, COMP, 10K +/-5%, 1/2W	109165	01121	EB1035	1		
R34	RES, COMP, 470 +/-5%, 1/4W	147983	01121	CB4715	REF		
S0	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	33		
S1	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S2	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S3	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S4	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S5	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S6	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S7	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S8	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S9	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S10	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S11	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S12	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S13	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S14	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S15	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S16	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S17	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S18	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S19	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S20	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S21	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S22	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S23	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S24	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S25	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S26	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S27	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S28	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S29	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S30	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S31	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
S32	SWITCH, DRY REED, SPST 3W, 40V	450627	89536	450627	REF		
U1	⊗ IC, C-MOS, 1-OF-10 DECODER	407981	12040	MM74C42	1		
XQ11	SPACER, XSTR MOUNTING, (NOT SHOWN)	152207	07047	10123-DAP	1		
XU1	SOCKET, IC, 16-PIN	276535	91506	316-AG39D	1		

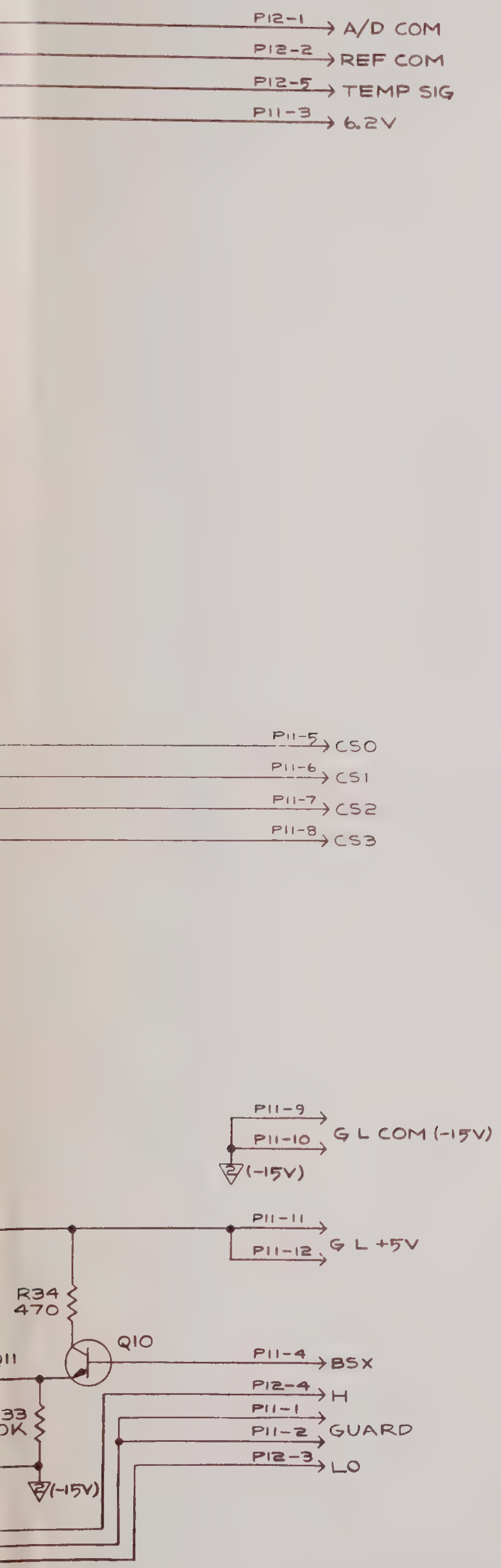

Q0
CR1
CR0
J14
Q1
Q2
CR3
CR2
Q3
Q4
CR5
CR4
Q5
Q6
CR7
CR6
Q7
Q8
CR9
CR8
Q9
CR10
R34
R33
Q11
Q12
Q10
U1
S0
S10
S20
S1
S11
S21
S2
S12
S22
S23
S13
S3
S24
S14
S4
S31
S32
S30
S29
S19
S9
S28
S18
S8
S27
S17
S7
S26
S16
S6
S25
S15
S5
R20
R0
R10
R21
R11
R1
R12
R2
R22
R3
R13
R23
R14
R4
R24
R15
R5
R25
R6
R16
R26
R7
R17
R27
R8
R18
R28
R9
R19
R29
J13
P11
P12


MP2
MP4
A06, A2
P14
H1 (5)
MP3
MP1
A06, A1
K0
K1
K2
K3
K4
K10
K9
K8
K7
K6
K5

2200A-1629

Figure 606-5. Low Level Scanner PCB Assembly


A/D COM
J13-8
REF COM
J13-10
TEMP SIG
J13-K
6.2V
J13-9
H0 J13-1 R0 470 S0
S0 J13-2 R10 470 S10
L0 J13-A R20 470 S20
GUARD J13-B GUARD
H1 J13-C R1 470 S1
S1 J13-D R11 470 S11
L1 J13-3 R21 470 S21
GUARD J13-4 GUARD
H2 J13-5 R2 470 S2
S2 J13-6 R12 470 S12
L2 J13-E R22 470 S22
GUARD J13-F GUARD
H3 J13-H R3 S3
S3 J13-J R13 S13
L3 J13-7 R23 S23
GUARD J13-M GUARD
H4 J13-12 R4 470 S4
S4 J13-11 R14 470 S14
L4 J13-N R24 470 S24
GUARD J13-13 GUARD
H5 J13-R R5 470 S5
S5 J13-P R15 470 S15
L5 J13-14 R25 470 S25
GUARD J13-S GUARD
H6 J13-16 R6 470 S6
S6 J13-15 R16 470 S16
L6 J13-T R26 470 S26
GUARD J13-17 GUARD
H7 J13-V R7 470 S7
S7 J13-U R17 470 S17
L7 J13-18 R27 470 S27
GUARD J13-W GUARD
H8 J13-20 R8 470 S8
S8 J13-19 R18 470 S18
L8 J13-X R28 470 S28
GUARD J13-21 GUARD
H9 J13-Z R9 470 S9
S9 J13-Y R19 470 S19
L9 J13-22 R29 470 S29
S30
S31
S32
K0
K1
K2
K3
K4
K5
K6
K7
K8
K9
K10
P14-1 J14-1
P14-2 J14-2
P14-3 J14-3
P14-4 J14-4
P14-5 J14-5
P14-6 J14-6
P14-7 J14-7
P14-8 J14-8
P14-9 J14-9
P14-10 J14-10
P14-12 J14-12
P14-11 J14-11
CR0
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
Q0
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q12
U1
Y ← X
1 2 3 4 5 6 7 8 9 10 11
0 1 2 3 4 5 6 7 8 9
A 15
B 14
C 13
D 12
BSL J13-L
GUARD


P12-1
A/D COM
P12-2
REF COM
P12-5
TEMP SIG
P11-3
6.2V
P11-5
CS0
P11-6
CS1
P11-7
CS2
P11-8
CS3
P11-9
P11-10
G L COM (-15V)
(-15V)
P11-11
P11-12
G L +5V
R34
470
Q10
P11-4
BSX
P12-4
H
P11-1
P11-2
GUARD
P12-3
LO
(-15V)

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ⬡ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2. AND Y32.14.
5. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
6. ALL VOLTAGES NOTED ARE WITH RESPECT TO A/D COM.

I.C. REF DES.	PIN NO.	
	G L +5V	G L COM
U1	16	8

2200A-1029

Figure 606-5. Low Level Scanner PCB Assembly (cont)

Option -07
Solder Pin Connector

607-1. INTRODUCTION

607-2. The Solder Pin Connector (Option -07) is a general purpose connector assembly which mounts in the rear of the data logger and provides electrical contact with the analog inputs of either the General Purpose Scanner or the Low Level Scanner. The connector is designed for use in fabricating a custom interface cable to provide external analog inputs to a single relay scanner (10 analog channels).

607-3. The connector assembly consists of a 44-pin board-edge connector which is mounted on a pcb housed in a clam-shell enclosure. The enclosure separates from the assembly to provide access to solder-type connections at the rear of the connector. Strain relief for the cable connections is provided by the enclosure.

607-4. SPECIFICATIONS

607-5. Specifications for the Solder Pin Connector are given in Table 607-1.

Table 607-1. Option -07 Specifications

Compatibility	Mates with either the -05 or -06 scanners
Terminal Style	Solder Type
Number of Terminals . .	30 (High, Low, Shield per channel)

607-6. CABLE FABRICATION

607-7. Figure 607-1 identifies the connector pins and signals necessary to interface external analog input data with either the General Purpose Scanner or the Low Level Scanner. Access to the solder-type terminals on the connector is accomplished by removing the four screws from the decal side of the connector enclosure. The decal identifies the pin connections and provides spaces for the user to uniquely identify the connector's block assignment and each of its channel inputs.

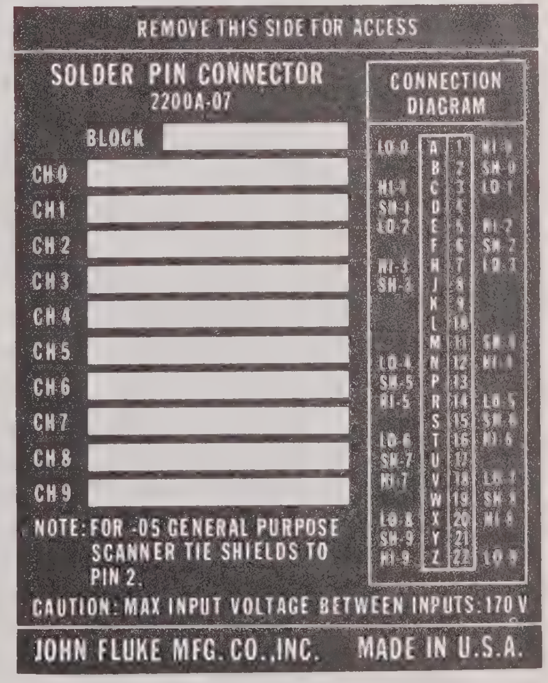

REMOVE THIS SIDE FOR ACCESS
SOLDER PIN CONNECTOR
2200A-07
BLOCK
CH 0
CH 1
CH 2
CH 3
CH 4
CH 5
CH 6
CH 7
CH 8
CH 9
NOTE: FOR -05 GENERAL PURPOSE SCANNER TIE SHIELDS TO PIN 2.
CAUTION: MAX INPUT VOLTAGE BETWEEN INPUTS: 170 V
CONNECTION DIAGRAM
LO 0 A 1 HI 0
B 2 SH 0
HI-1 C 3 LO 1
SH-1 D 4
LO-2 E 5 HI 2
F 6 SH 2
HI-3 H 7 LO 3
SH-3 J 8
K 9
L 10
M 11 SH 4
LO-4 N 12 HI 4
SH-5 P 13
HI-5 R 14 LO 5
S 15 SH 6
LO-6 T 16 HI 6
SH-7 U 17
HI-7 V 18 LO 7
W 19 SH 8
LO-8 X 20 HI 8
SH-9 Y 21
HI-9 Z 22 LO 9
JOHN FLUKE MFG. CO., INC. MADE IN U.S.A.

Figure 607-1. Solder Pin Connector Pin Assignments

607-8. INSTALLATION

607-9. The Solder Pin Connector and cable assembly mounts in any one of the available scanner-block slots containing a scanner module. See Figure 607-2. Install the Solder Pin Connector as follows:

1. Using your fingers, unlatch the two slide fasteners located on either side of the protruding enclosure on the rear of the data logger. Remove the enclosure from the rear panel.
2. Locate the desired scanner-block slot on the rear panel and check to ensure that a scanner module is installed in the slot.
3. With the connector key toward the top, position the Solder Pin Connector in the guides of the selected scanner block and mate it with the scanner's connector.
4. Install the retaining screws and washers that hold the input connector to the data logger.
5. After the required number of input connectors are installed, install the rear panel enclosure.

607-10. LIST OF REPLACEABLE PARTS

607-11. A list of replaceable parts for the Solder Pin Connector Assembly is given in Table 607-2. Refer to Section 5 of this manual for ordering information.

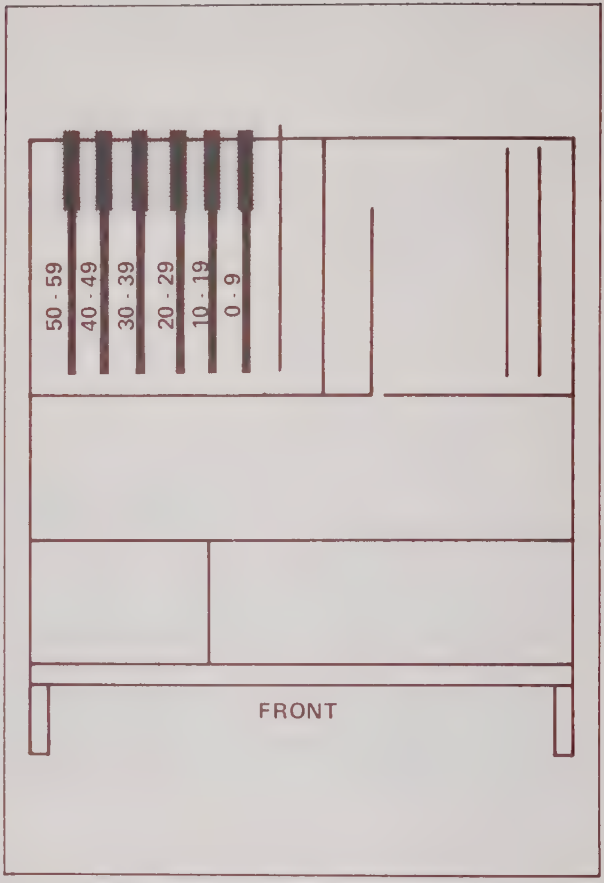


Figure 607-2. Solder Pin Connector Mounting Locations

Table 607-2. Solder Pin Connector Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	SOLDER PIN CONNECTOR ASSEMBLY FIGURE 607-3 (2200A-07)						
H1	SCREW, PHP, 4-40 X 5/8	145813	89536	145813	2		
H2	SCREW, PHP, S/S, 4-40 X 7/8	335133	89536	335133	2		
H4	NUT, 4-40	110635	89536	110635	2		
H5	WASHER, FLAT	110775	89536	110775	2		
H6	WASHER, FLAT #4	146225	89536	146225	2		
H7	WASHER, LOCK #4	110395	89536	110395	2		
MP1	HOUSING, PLASTIC	414276	89536	414276	2		
	CONNECTOR BOARD ASSEMBLY						
	CONNECTOR PCB	373332	89536	373332	1		
	CONNECTOR, BOARD-EDGE, 44-PIN	385666	13511	225-22221-101	1		
	KEY, CONNECTOR, POLARIZING	407254	13511	225-22221-101-22	1		

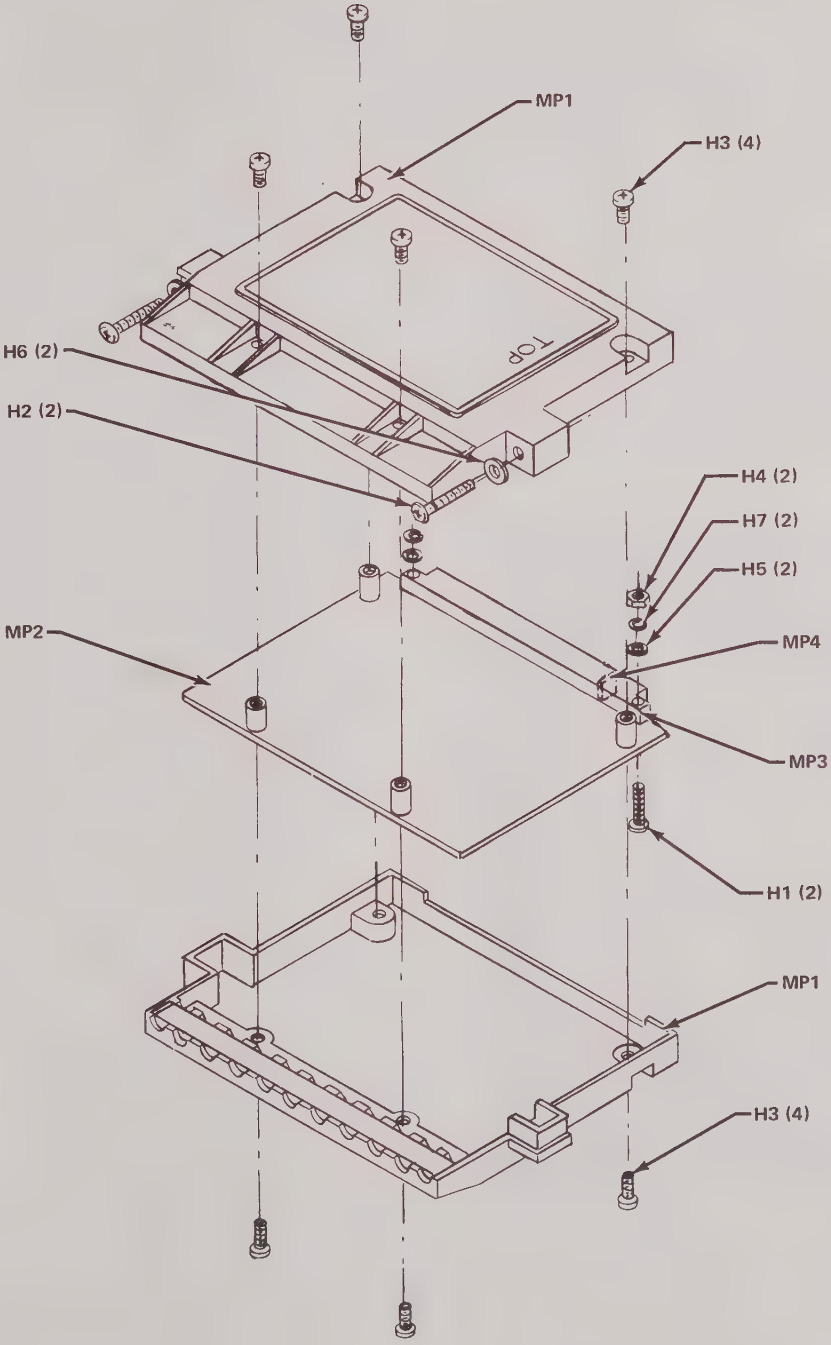

MP1
H3 (4)
H6 (2)
H2 (2)
TOP
H4 (2)
H7 (2)
H5 (2)
MP2
MP4
MP3
H1 (2)
MP1
H3 (4)

Figure 607-3. Solder Pin Connector Assembly

Option -08
Isothermal Block Connector

608-1. INTRODUCTION

608-2. The Isothermal Block Connector (Option -08) is a 44-pin card-edge connector assembly designed for inputting low level thermocouple voltages and/or general purpose dc voltages to either the General Purpose Scanner (Option -05) or the Low Level Scanner (Option-06). Convenient screw-type input terminals are used to provide a fast and reliable method of completing the input connections. These terminals are thermally integrated into an isothermal block which is allowed to drift with ambient temperature. A temperature measuring circuit monitors the block temperature, and returns a proportional voltage to the data logger. This voltage is used by the data logger to calculate the temperature represented by each of up to 10 thermocouple- generated input voltages (i.e., one per channel). The temperature measuring feature does not interfere with ordinary voltage measurements.

608-3. SPECIFICATIONS

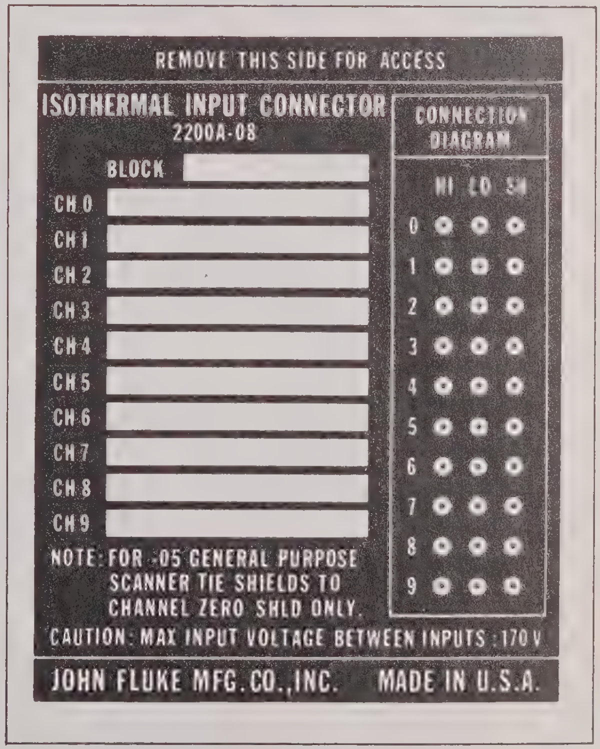
608-4. Specifications for the Isothermal Block Connector are given in Table 608-1.

Table 608-1. Option -08 Specifications

Compatibility	Mates with either the -05 or -06 scanners
Terminal Style	Screw Type
Number of Terminals	30 (High, Low, Shield per channel
Temperature Gradient . . . . between any terminals	±0.05°C maximum
Reference Junction Stability .	±0.005°C per ° (0°C to 50°C)

608-5. INPUT CONNECTIONS

608-6. Figure 608-1 identifies the location of the high, low and shield input terminals for each of the 10 scanner channels. Access to the terminals is accomplished by removing the four screws from the decal-side of the connector enclosure. As input connections are completed, use the spaces provided on the connector decal to uniquely identify the connectors block (slot) assignment and each of its channel input signals.



NOTE: FOR -05 GENERAL PURPOSE SCANNER TIE SHIELDS TO CHANNEL ZERO SHLD ONLY.

CAUTION: MAX INPUT VOLTAGE BETWEEN INPUTS: 170 V

Figure 608-1. Isothermal Block Connector Terminal Assignments

608-7. INSTALLATION

608-8. The Isothermal Block Connector can be mounted in any one of the data logger scanner-block slots which contain a relay scanner (Option -05 or -06). See Figure 608-2. Install the connector as follows:

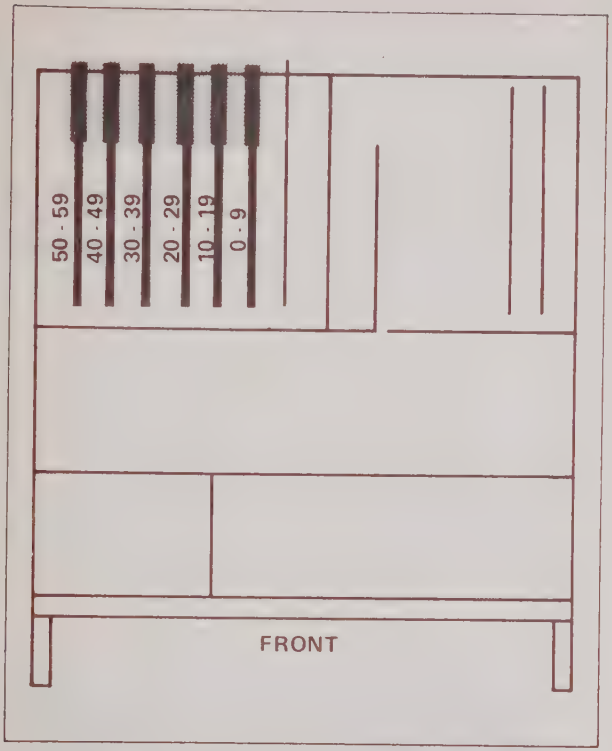


Figure 608-2. Isothermal Block Connector Mounting Locations

1. Using your finger, unlatch the slide fasteners located on either side of the protruding enclosure at the rear of the data logger. Remove the enclosure from the rear panel.

2. Locate the desired scanner-block slot on the rear panel and check to ensure that a scanner module is installed in the slot.

3. With the connector key toward the top, position the Isothermal Block Connector in the guides of the selected slot and mate it with the scanner's connector.

4. Install the retaining screws and washers that hold the input connector to the data logger.

5. After the required number of input connectors are installed, install the rear panel enclosure.

608-9. OPERATION

608-10. Once installed, the Isothermal Block Connector requires no operator attention other than ensuring that the programmed function and/or range for each channel is compatible with the input signal source. For example, if the channel 0 input signal is derived from a thermocouple and a temperature reading is required, the programmed function must be in terms of temperature and thermocouple probe type (T1, T2, T3 or T4). Programming a voltage range in this case would be meaningless.

608-11. THEORY OF OPERATION

608-12. The Isothermal Block Connector provides the connections necessary for supplying voltage and/or (thermocouple) temperature inputs to any 10 scanner channels. Input connections are in the form of 10 sets of 3 screw terminals (high, low and guard). The input signals at any given channel are measured in terms of voltage when a voltage function is programmed and in terms of temperature when a temperature function (T1, T2, T3 or T4) is programmed.

608-13. When a temperature function is programmed for a particular channel, it is assumed that a thermocouple probe (compatible with the selected function T1, T2, T3 or T4) is providing the input signal to that channel. Under these conditions the Isothermal Block Connector provides the microprocessor with the information necessary to compute the actual temperature at the thermocouple probe. This information includes the thermocouple voltage at the input terminals and a voltage indicative of the thermocouple input terminal temperature. The thermocouple input voltage is a direct result of the probe temperature versus the input terminal temperature. The input terminal temperature is measured by a separate sensing circuit and is electrically isolated from the thermocouple connections.

608-14. The temperature sensing circuit consists of a forward biased semiconductor junction which is thermally integrated into an anodized aluminum block. This block also surrounds and thermally integrates each of the 30 screw-type input terminals. The mass and temperature response of the block is such that the input terminal temperatures and the semiconductor sensor are held to within less than ±0.05°C of each other. Actual block temperature is allowed to vary with ambient temperature.

608-15. When a relay scanner is addressed the temperature sensing circuit provides the microprocessor with a voltage input proportional to the temperature of the isothermal block. This method of compensating a thermocouple reference junction is accurate over a temperature range of 0 to 50°C.

608-16. CALIBRATION

608-17. The temperature sensor on the Isothermal Block Connector has been calibrated at the factory and does not require periodic calibration to meet the specifications given in Section 1. However, calibration is required after the connector undergoes repair, or if the seal on the factory adjustment has been broken. The required equipment is listed in Table 608-2. Use the following procedure to calibrate the reference junction:

Table 608-2. Equipment Required for Calibration

DESCRIPTION	RECOMMENDED MODEL OR TYPE
Data Logger	Fluke 2200B/2240B
Low Level Scanner	Fluke 2200A–06
Thermocouple Probe	Type J, K, or T (select type compatible with data logger being used)
Mercury Thermometer, 0.02°C Resolution	Princo ASTM-56C
Dewar Flask and Cap	1-pint Thermos Bottle

1. Calibrate the A/D Converter.

2. Install the Low Level Scanner (Option -06) in block 0 of the data logger.

3. Connect the thermocouple probe to the Channel 4 terminals on the Isothermal Block Connector. Leave the terminal side of the connector cover off during the calibration procedure.

4. Attach the Isothermal Block Connector to the scanner in slot 0.

5. Prepare a room-temperature lag bath using the thermos bottle, and insert the thermometer and the thermocouple probe into the bath. (Allow the lag bath at least 15 minutes to stabilize.)

6. Energize the data logger and program it as follows:

   a. Set Monitor channel to 4.

   b. Select temperature function (T1, T2, T3 or T4) that is compatible with the thermocouple probe.

   c. Depress the MONITOR scan control switch.

7. The data logger display should read the temperature of the lag bath as indicated by the mercury thermometer. If the display is in error, slowly adjust the pot on the Isothermal Block Connector while observing the display. The adjustment is correct when the display agrees with the thermometer reading and remains constant for at least 30 seconds.

608-18. LIST OF REPLACEABLE PARTS

608-19. A list of replaceable parts for the Isothermal Block Connector is given in Table 608-3. Refer to Section 5 of this manual for ordering information.

Table 608-3. Isothermal Block Connector Assembly

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ISOTHERMAL BLOCK CONNECTOR FIGURE 608-3 (2200A-08)	OPT-08	89536	ORDER BY OPT. -08			
	ISOTHERMAL INPUT PCB ASSEMBLY	440248	89536	440248	1		
C1	CAP, CER, 0.05 UF +/-20%, 50V	149161	56289	55C23A1	1		
H1	SCREW, PhP, 4-40 X 1/2	152132	73734	19026	7		
H2	SCREW, PHP, 4-40 X 7/8	335133	89536	335133	2		
H3	SCREW, PHP, CAD, 6-32 X 1/4	152140	73734	19042	8		
H4	SCREW, PHP, S/S, 6-32 X 1/4	385401	89536	385401	30		
H5	WASHER, FLAT, #4	146225	86928	5710-18-32	2		
MP1	INSULATOR, ISOTHERMAL BLOCK	373340	89536	373340	1		
MP2	ISOTHERMAL BLOCK	412379	89536	412379	1		
MP3	KEY, CONNECTOR, POLARIZING	407254	54453	ISM-K1	1		
MP4	DECAL, ISOTHERMAL	423517	89536	423517	1		
MP5	CONNECTOR, HOUSING	414276	89536	414276	2		
MP6	SOCKET, COMP. LEAD	343285	00779	2-331272-6	2		

Table 608-3. Isothermal Block Connector Assembly (cont)

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
P13	CONNECTOR, BOARD-EDGE, 44-PIN	385674	13511	225-22221-105	1		
Q1	XSTR, SI, PNP (SELECTED)	380394	89536	380394	1	1	
Q2	XSTR, FET, N-CHANNEL	357905	89536	357905	1	1	
R1	RES, COMP, 330K +/-5%, 1/4W	192948	01121	CB3345	1		
R2	RES, COMP, 4.7K +/-5%, 1/4W	148072	01121	CB4725	1		
R3	RES, MF, 130K +/-1%, 1/8W	221648	91637	MFF1-81303F	1		
R4	RES, MF, 100K +/-1%, 1/8W	248807	91637	MFF1-81003F	1		
R5	RES, VAR, CERMET, 150K +/-10%, 300V	414102	11236	360T151A	1	1	

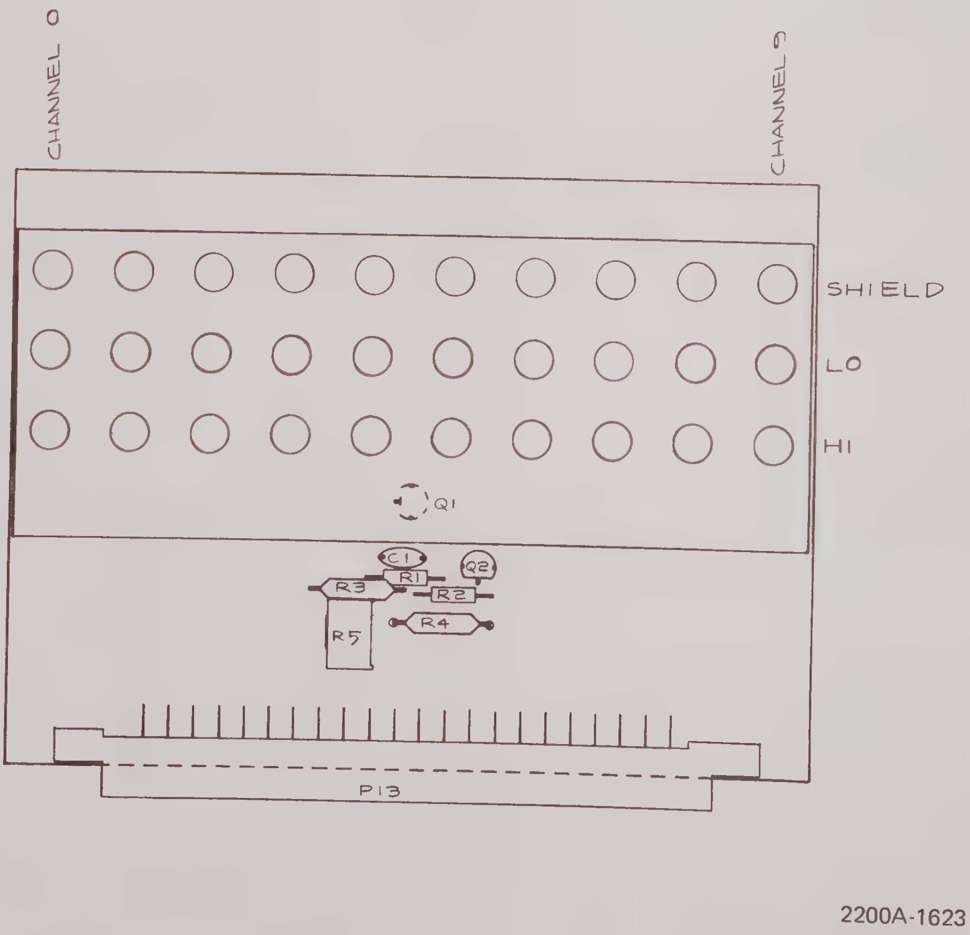
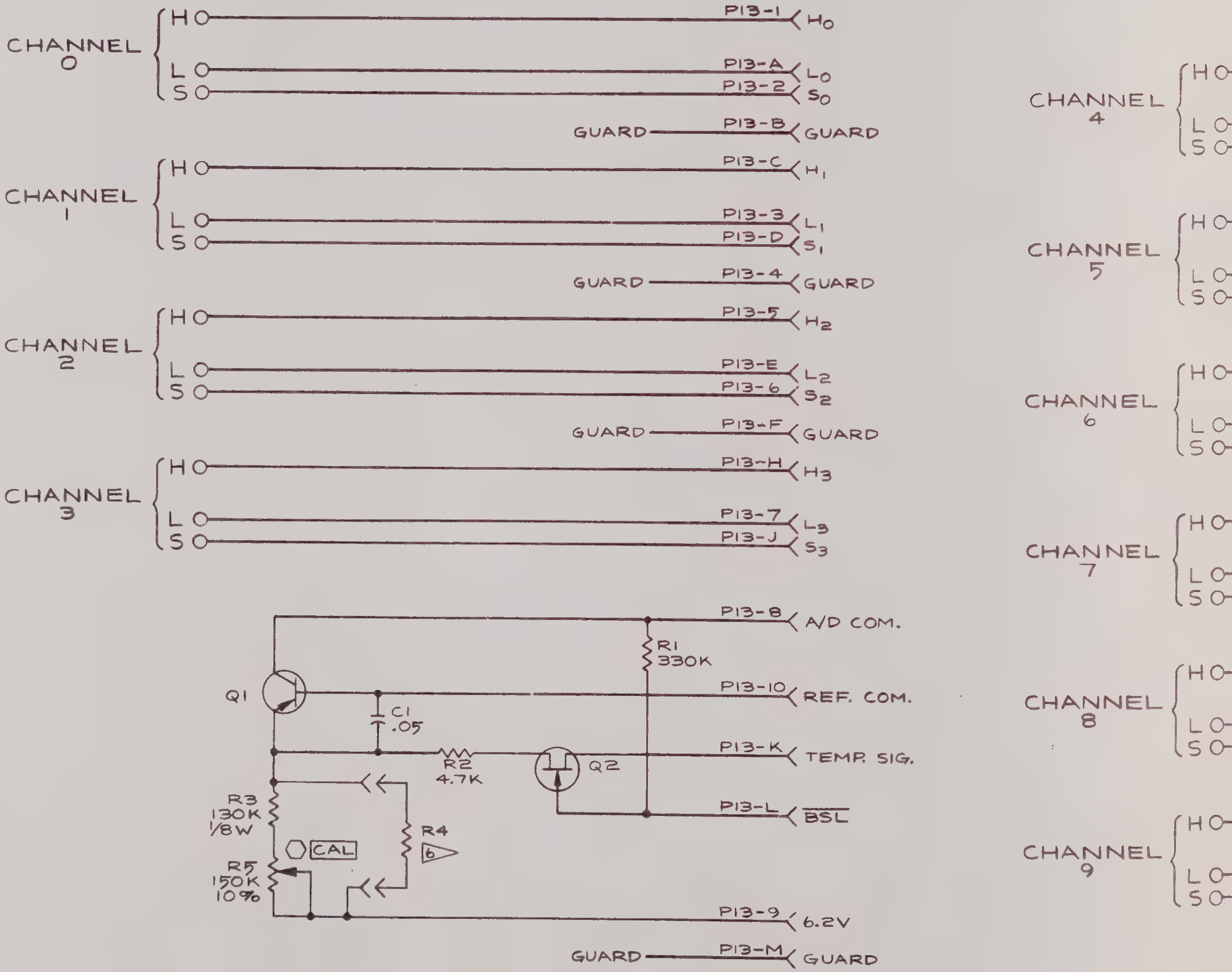
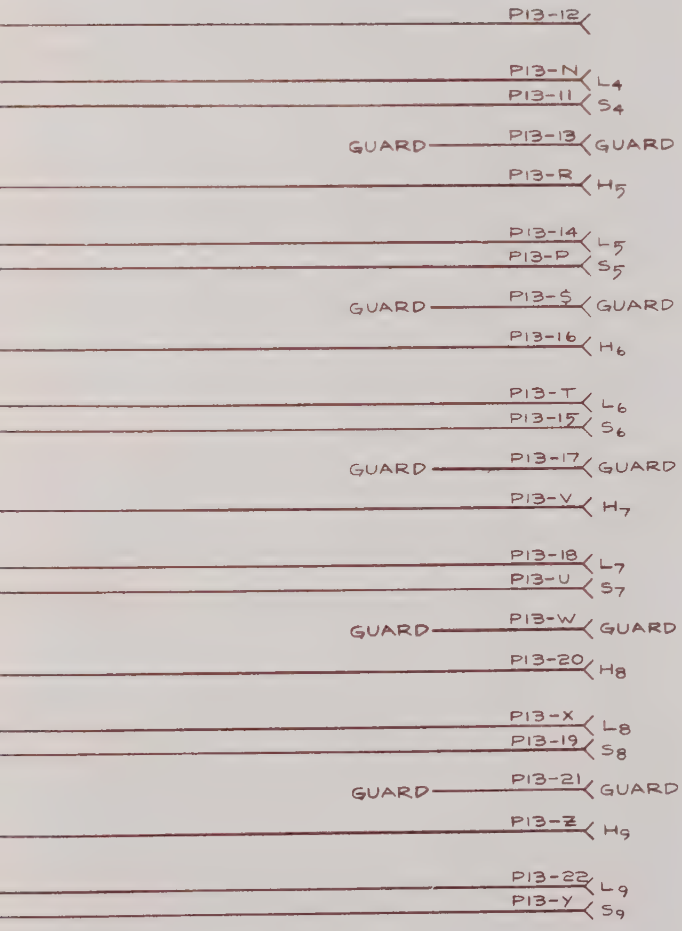

CHANNEL 0
CHANNEL 9
SHIELD
LO
HI
Q1
C1
Q2
R1
R3
R2
R4
R5
P13
2200A-1623

Figure 608-3. Isothermal Block Connector Assembly


CHANNEL 0
H
L
S
P13-1
H0
P13-A
L0
P13-2
S0
GUARD
P13-B
GUARD
CHANNEL 1
H
L
S
P13-C
H1
P13-3
L1
P13-D
S1
GUARD
P13-4
GUARD
CHANNEL 2
H
L
S
P13-5
H2
P13-E
L2
P13-6
S2
GUARD
P13-F
GUARD
CHANNEL 3
H
L
S
P13-H
H3
P13-7
L3
P13-J
S3
P13-8
A/D COM.
R1
330K
Q1
P13-10
REF. COM.
C1
.05
R2
4.7K
Q2
P13-K
TEMP. SIG.
P13-L
BSL
R3
130K
1/8W
R4
6
CAL
R5
150K
10%
P13-9
6.2V
GUARD
P13-M
GUARD
CHANNEL 4
CHANNEL 5
CHANNEL 6
CHANNEL 7
CHANNEL 8
CHANNEL 9
H
L
S

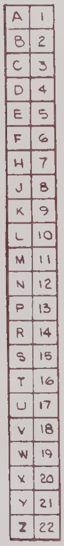

P13-12
P13-N
L4
P13-11
S4
GUARD
P13-13
GUARD
P13-R
H5
P13-14
L5
P13-P
S5
GUARD
P13-$
GUARD
P13-16
H6
P13-T
L6
P13-15
S6
GUARD
P13-17
GUARD
P13-V
H7
P13-18
L7
P13-U
S7
GUARD
P13-W
GUARD
P13-20
H8
P13-X
L8
P13-19
S8
GUARD
P13-21
GUARD
P13-Z
H9
P13-22
L9
P13-Y
S9

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ⬡ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2.

5 R4 IS FACTORY SELECTED AND IS ONE OF THE LISTED VALUES:

OPEN	100K
287K	76.8K
147K	



A	1
B	2
C	3
D	4
E	5
F	6
H	7
J	8
K	9
L	10
M	11
N	12
P	13
R	14
S	15
T	16
U	17
V	18
W	19
X	20
Y	21
Z	22

REAR VIEW OF P13

2200A-1023

Figure 608-3. Isothermal Block Connector Assembly (cont)

—12 Series
Teleprinter and RS-232-C Interface Options

612-1. SCOPE

612-2. The —12 Series Options include Options —12B through —12P and most are described in Section 1 of the data logger manual. Each option in the series is compatible with a commercially available teleprinter or RS-232-C compatible recorder. The information contained herein deals with the basic Digital Output PCB used to interface these recorders

612-3. INTRODUCTION

612-4. The Digital Output PCB is designed to transfer bit serial/character-serial data from the data logger to an external recording peripheral. This includes: Time-of-Year (2240B), Fixed Data (2240B), Scan Counter (2200A), Digital Input Data (Option —16), and measurement data. The appropriate carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote start input.

612-5. A unique interface cable and a series of 24 switches on the pcb are used to tailor the digital output to the recorder. The cable is included as part of the option. The switches are set by the user to define recorder baud rate and data format.

612-6. The pcb used with the —12 Series options is capable of operating as either an RS-232-C or a 20 mA current loop interface. For current loop operation a relay on the pcb opens and closes the loop for character transmission. The 20 mA current source must be resident in the Teletypewriter.

612-7. Table 612-1 defines the configuration of each available option in the -12 series, as well as, its intended interface type; current loop or RS-232-C. Order by option number and description.

612-3. SPECIFICATIONS

612-9. Specifications for the —12 series of options are given in Table 612-2.

Table 612-1. Configuration of —12 Series Options

OPTION NO.	DESCRIPTION	OPTION COMPONENTS (INDICATED BY ●)				INTERFACE TYPE	
		PCB	CABLE	RECORDER	HARD-WARE	20 mA	RS-232C
—12B	ASR-33 Interface	●	●			x	
—12C	TI733 KSR/RO Interface	●	●				x
—12L	RS-232C General Purpose Terminal Interface	●	●				x
—12M	RS-232C General Purpose Modem Interface	●	●				x
—12N	Tektronix 4923 and Interface	●	●	●			x
—12P	Tektronix 4923 Cartridge Recorder			●			x

Table 612-2. –12 Series Option specifications

Compatibility	Specify at time of purchase, using alphabetic suffix as shown in Table 617-1
Output Format	Bit-serial
Output Levels	20 mA dc current loop (–12B) and EIA Standard RS-232C (–12C, –12E, –12H, –12L, –12M, –12N)
Output Code	ASCII 7-level (no parity bit)
Measurements per Line	1 through 16, switch selectable
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed
Record Format	CR, LF (Carriage Return, Line Feed) Time-of-Day (days, hrs., min., s) CR, LF CR, LF (not in –12C), fixed Data, CR, LF Digital Inputs CR, LF (–16 Option) Channel, limit, sign, data , range, function, CR, LF
Baud Rate	
RS-232-C	110, 300, 1200, 2400, 4800 (Switch selectable)
20 mA Current Loop	110
–12C	110, 300

612-10. INSTALLATION

612-11. Digital Output PCB

612-12. Up to three Digital Output PCB's can be mounted in the data loggers I/O slots, as shown in Figure 612-1. Install each —12 Series pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

a. Set the data logger POWER switch to OFF.

b. Remove the top cover from the data logger.

c. Locate the Data Format switches on each —12 Series Digital Output PCB, as shown in Figure 612-1.

d. With reference to Figure 612-2, establish the format of recorded data as follows:

   1. Set switches 0 through 23 to OFF. This establishes the format shown in Figure 612-2.
   2. Delete any combinations of unwanted character segments by setting the assigned switches to ON.
   3. Set the desired baud rate using switches 16 through 19.
   4. If a TTY is used to record data, set switches 12 through 15 to the desired number of readings per line minus 1. For example, a setting of 0000 is equal to 1 reading per recorded line. The total number of characters and space per line cannot exceed the number of columns available on the TTY (80 typical).

NOTE

Set unused switches to OFF.

e. Align each Digital Output PCB in its selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.

f. After the Digital Output PCB(s) is (are) installed, install the top cover.

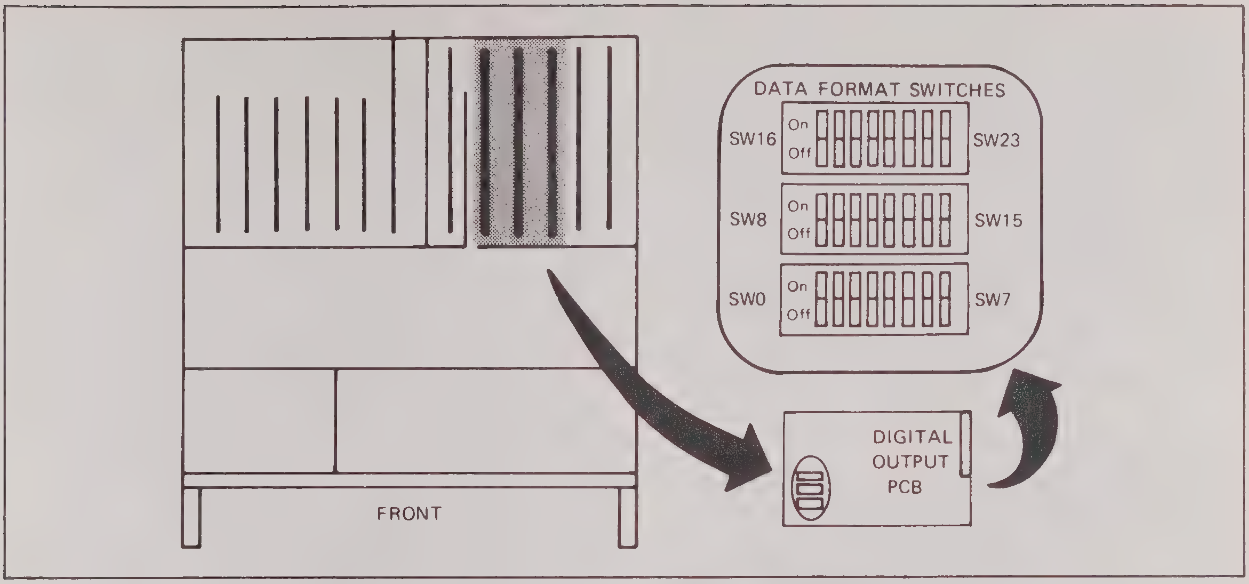
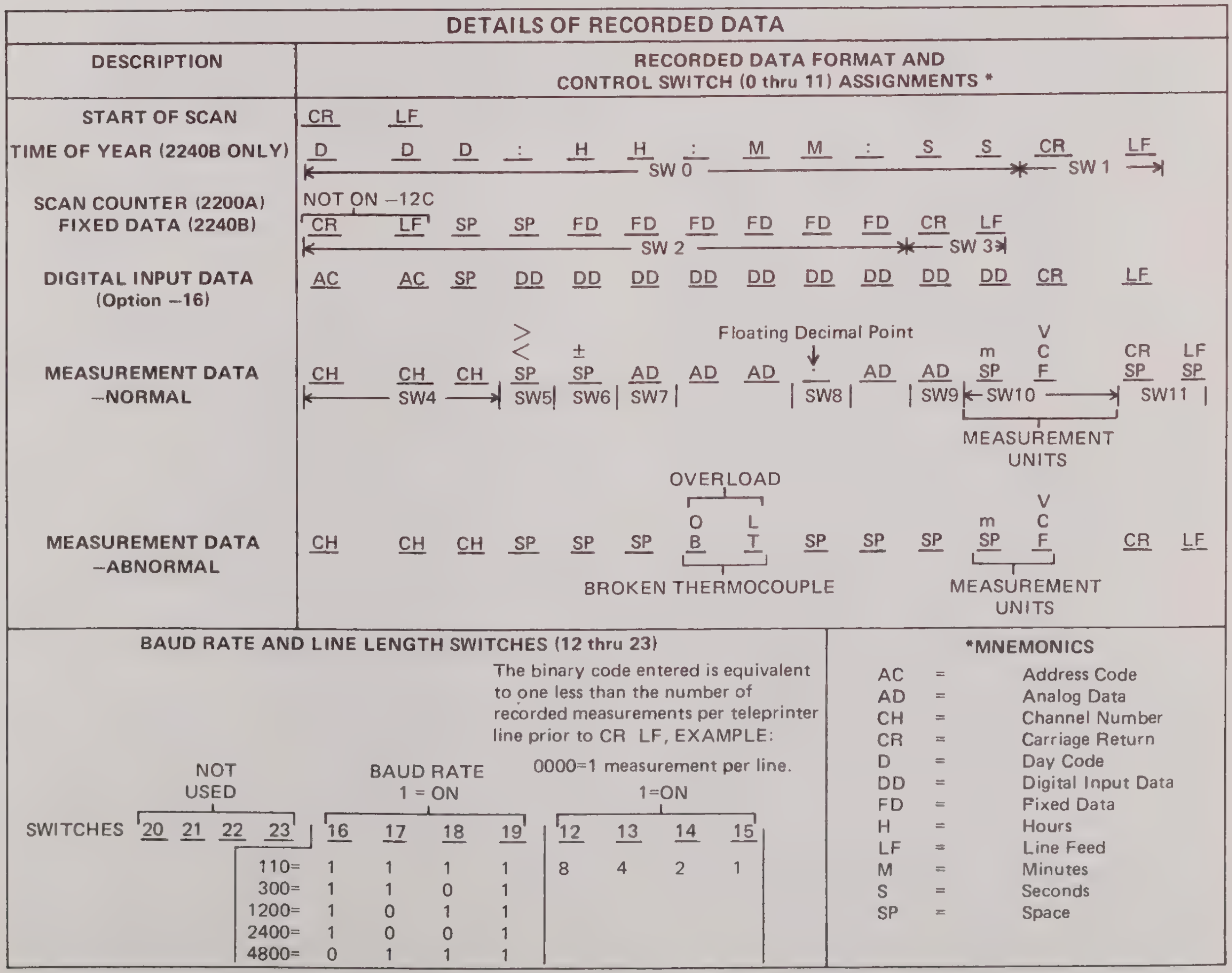


Figure 612-1. Digital Output PCB Installation and Switch Locations



DETAILS OF RECORDED DATA

DESCRIPTION	RECORDED DATA FORMAT AND CONTROL SWITCH (0 thru 11) ASSIGNMENTS *
START OF SCAN	CR LF
TIME OF YEAR (2240B ONLY)	D D D : H H : M M : S S CR LF |← SW 0 →|← SW 1 →|
SCAN COUNTER (2200A) FIXED DATA (2240B)	NOT ON –12C (CR LF) CR LF SP SP FD FD FD FD FD FD CR LF |← SW 2 →|← SW 3 →|
DIGITAL INPUT DATA (Option –16)	AC AC SP DD DD DD DD DD DD DD DD DD CR LF
MEASUREMENT DATA –NORMAL	CH CH CH >/< SP ± SP AD AD AD (Floating Decimal Point ↓ ·) AD AD m SP V C F CR SP LF SP |← SW4 →| SW5 | SW6 | SW7 | | SW8 | | SW9 |← SW10 →| SW11 | MEASUREMENT UNITS (m SP V C F)
MEASUREMENT DATA –ABNORMAL	CH CH CH SP SP SP O B L T SP SP SP m SP V C F CR LF OVERLOAD (O L) — BROKEN THERMOCOUPLE (B T) MEASUREMENT UNITS (m SP V C F)

BAUD RATE AND LINE LENGTH SWITCHES (12 thru 23)

The binary code entered is equivalent to one less than the number of recorded measurements per teleprinter line prior to CR LF, EXAMPLE:

0000=1 measurement per line.

	NOT USED				BAUD RATE 1 = ON				1=ON			
SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
110=					1	1	1	1	8	4	2	1
300=					1	1	0	1				
1200=					1	0	1	1				
2400=					1	0	0	1				
4800=					0	1	1	1				

***MNEMONICS**

AC = Address Code
AD = Analog Data
CH = Channel Number
CR = Carriage Return
D = Day Code
DD = Digital Input Data
FD = Fixed Data
H = Hours
LF = Line Feed
M = Minutes
S = Seconds
SP = Space

Figure 612-2. Recorded Data Format and Digital Output PCB Switch Assignments

612-13. Interface Cable

612-14. The interface cable supplied with the Digital Output PCB is designed to interface a specific recording device (see Section 1 of the data logger). If data logger scan sequences are to be initiated manually using the front-panel switches, connect the interface cable between the Digital Output PCB's rear-panel connector and the appropriate recorder. If the scan sequences are to be initiated by a remote input, complete the following procedure prior to connecting the interface cable:

b. Locate the three coiled wires stowed inside the hood.

a. Remove the hood from the 50-pin connector which mates with the Digital Output PCB.

c. Uncoil the wires and identify each prior to reassembling the connector.

   1. Pin 31 — Start
   2. Pin 6 — Scan in Progress (SIP)
   3. Pin 48 — Logic Common

d. Install the interface cable and connect the remote control lines to the desired source. The function of each line is described below:

   1. START — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.

   2. SIP (Scan in Progress) — This TTL output goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.

   3. LOGIC COMMON — Logic common for the start input and SIP output signals.

NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

612-15. OPERATION

612-16. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given earlier under Installation. Refer to the appropriate teleprinter/cassette-recorder instruction manual for additional recorder information.

612-17. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed and an EXTERNAL ENABLE switch is depressed (preferrably ALL DATA) the following conditions will assure a start of scan.

a. Apply a momentary contact closure to ground or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input), allow the first scan sequence to complete. SIP will return high at the end of the sequence, and will go low for subsequent scan sequences.

b. While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ⩾5 ms will cause a remote start.

c. Under worst case keyboard activity, a Start pulse ⩾100 ms is required to ensure a remote start.

d. If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

612-18. THEORY OF OPERATION

612-19. The Digital Output PCB, as shown in Figure 612-3, is a microprocesssor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day, digital data,heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accommodated by the interface. Among these are: a 20 mA current-loop teleprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined, the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interface cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they apply to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) an SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

612-20. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

612-21. When the Controller is ready to initiate a data transfer it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 612-3 lists the possible responses and their meanings.

Table 612-3. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

612-22. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto Control Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an Interrupt to the MPU and an input-Enable to the 4-bit Input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered into the Input Register. As a result of the high Interrupt and Test inputs, the MPU generates a low Interrupt Acknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral device, see Table 612-3.) At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

612-23. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

612-24. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

612-25. The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output date in a bit-serial-by-character format, as well as, a bit-prallel-by-character format, each process will be considered separately.

612-26. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is issued, and the write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

612-27. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

612-28. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 612-3). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus) and read into the Memory Interface as six 4-bit characters. To read each character the MPU causes the RAM to sequentially place binary coded numbers 0 through 5 onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches.) As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

612-29. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs/outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

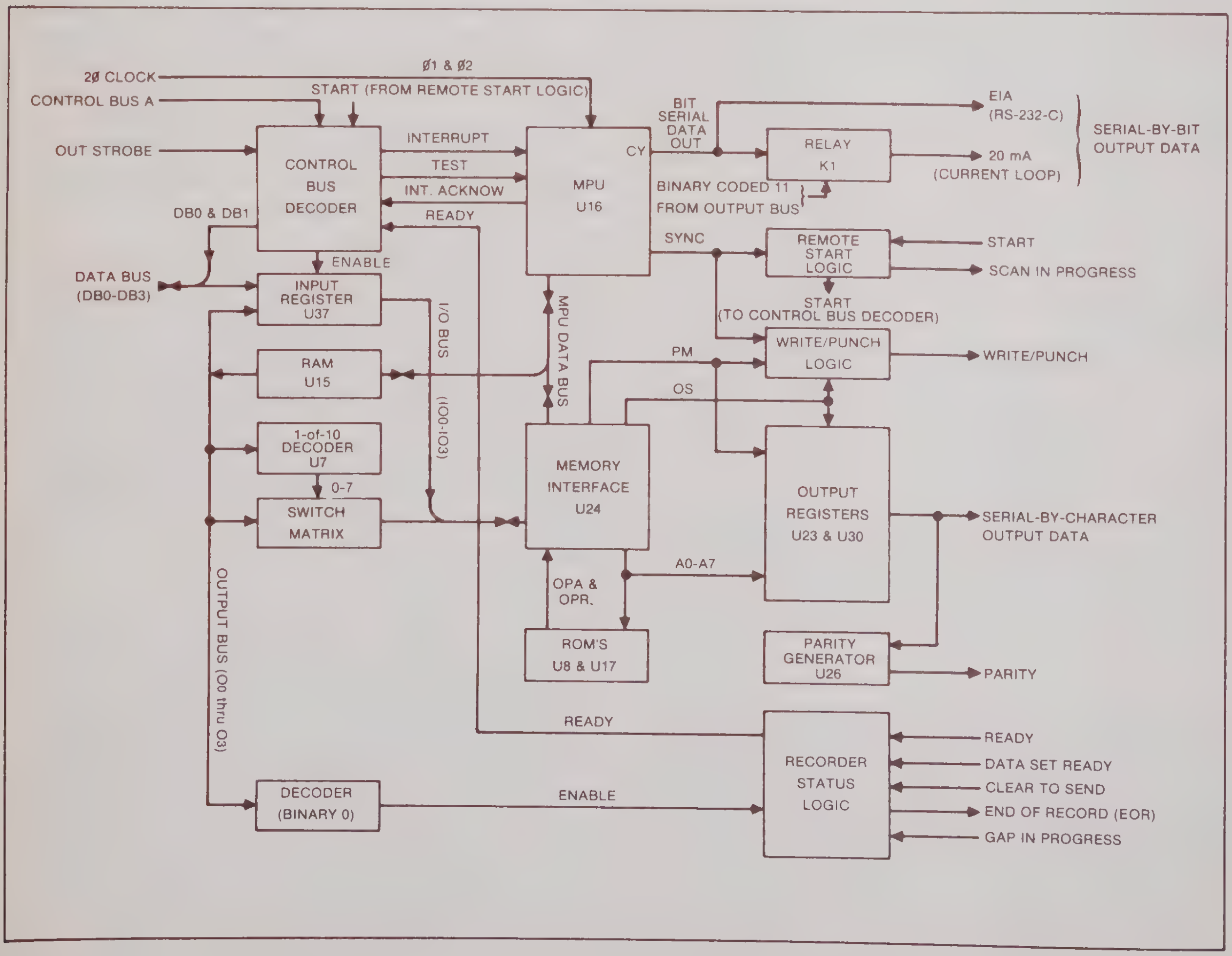

2Ø CLOCK
Ø1 & Ø2
CONTROL BUS A
START (FROM REMOTE START LOGIC)
OUT STROBE
CONTROL BUS DECODER
INTERRUPT
TEST
INT. ACKNOW
READY
MPU U16
CY
BIT SERIAL DATA OUT
RELAY K1
EIA (RS-232-C)
20 mA (CURRENT LOOP)
SERIAL-BY-BIT OUTPUT DATA
BINARY CODED 11 FROM OUTPUT BUS
DB0 & DB1
DATA BUS (DB0-DB3)
ENABLE
INPUT REGISTER U37
SYNC
REMOTE START LOGIC
START
SCAN IN PROGRESS
START (TO CONTROL BUS DECODER)
I/O BUS
MPU DATA BUS
RAM U15
PM
WRITE/PUNCH LOGIC
WRITE/PUNCH
OS
(IO0-IO3)
1-of-10 DECODER U7
0-7
SWITCH MATRIX
MEMORY INTERFACE U24
OUTPUT REGISTERS U23 & U30
SERIAL-BY-CHARACTER OUTPUT DATA
A0-A7
OPA & OPR.
ROM'S U8 & U17
PARITY GENERATOR U26
PARITY
OUTPUT BUS (O0 thru O3)
READY
RECORDER STATUS LOGIC
READY
DATA SET READY
CLEAR TO SEND
END OF RECORD (EOR)
GAP IN PROGRESS
DECODER (BINARY 0)
ENABLE

Figure 612-3. Digital Output PCB Simplified Block Diagram

612-30. The Remote Start Logic, upon receipt of an external Start command, alters the Digital Output PCB's status response so as to initiate a data logger scan sequence (see Table 612-3). An acceptable start input is a ≥5 ms contact closure to ground while the Scan-in-Progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan (binary coded 9) character with the normal data transfer characters. These two characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

612-31. MAINTENANCE

612-32. Access Information

612-33. Refer to the installation instructions given earlier in paragraph 612-11 for Digital Output PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

612-34. Performance Test

612-35. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

612-36. LIST OF REPLACEABLE PARTS

612-37 The lists of replaceable parts for the —12 series of data logger options are given in Tables 612-4, -5, and -6. Refer to Section 5 of the data logger manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 612-4. –12 Options Final Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, –12 SERIES OPTIONS						
–12B	ASR33 INTERFACE 1, 2, 5, 6 1▷				1		
–12C	T1733 KSR/RO INTERFACE 1, 3, 5, 6 1▷				1		
–12L	RS-232C GENERAL PURPOSE TERMINAL INTERFACE 1, 3, 5, 6 1▷						
–12M	RS-232C MODEM INTERFACE 1, 4, 5, 6 1▷						
–12N	TEKTRONIX 4923 AND INTERFACE 1, 4, 5, 6, 8, 9, 10 1▷				1		
–12P	RECORDER, MAG TAPE, TEKTRONIX 4923				1		
1▷	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 612-5.	409254	89536	409524	1		
2	ASR33 Interface Cable Assembly. See Table 612-6.	378349	89536	378349	1		
3	TI Silent 700 Interface Cable Assembly. See Table 612-6.	430785	89536	430785	1		
4	RS-232 Interface Cable Assembly. See Table 612-6.	433045	89536	433045	1		
5	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
6	Jumper, plug-in (10 pack)	373316	89536	373316	1		
8	Recorder, Mag Tape, Tektronix 4923	461848	89536	461848	1		
9	Res, comp, 1k ±5%m 1/4W (R10 or R11)	148023	01121	CB1025	1		
10	IC, TTL, hex buffer/driver with open collector (U31 and U33)	328021	01295	SN7417N	2		

Table 612-5. Digital Output PCB Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	**DIGITAL OUTPUT PCB ASSEMBLY, OPTION –12 (2200A-4014) Figure 612-4.**	409524	89536	409524	REF		
C1	Cap, mica, 400 pF +1%, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF ±10%, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μF ±20%, 20V	330662	56289	196D106X0020-KA1	1		
C5	Cap, cer, 0.68 μF -20/+80%, 25V	179077	56289	5C023684D8250-B3	1		
CR1, CR3 thru CR28	Diode, Si, switching	203332	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k ±5%, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k ±5%, 1/4W	148106	01121	CB1035	6		
R3, R4, R26	Res, comp, 13k ±5%, 1/4W	221598	01121	CB1335	3		
R5 thru R9, R12, R14, R16 thru R19	Res, comp, 1k ±5%, 1/4W	148023	01121	CB1025	11		
R15	Res, comp, 200 ±5%, 1/4W	193482	01121	CB2015	1		
R23	Res, comp 3.3k ±5%, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer ⊗	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 612-5. Digital Output PCB Assembly (cont)

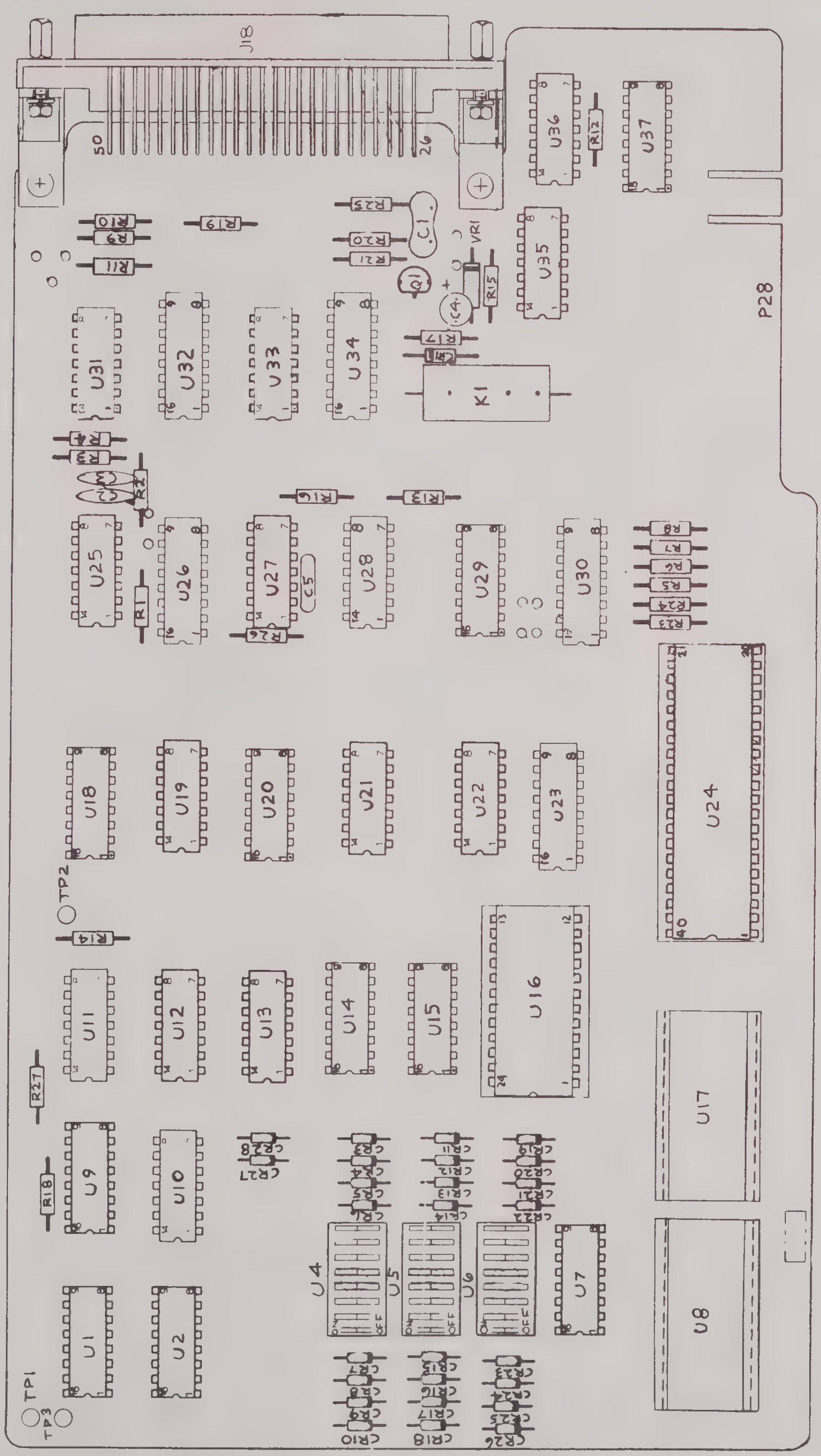
REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder ⊗	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop ⊗	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop ⊗	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate ⊗	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter ⊗	355214	04713	MC14007CP	3	1	
U15	IC, PMOS, 320-bit RAM and 4-bit output port ⊗	40442	34649	P4002-1	1	1	
U16	IC, MOS, central processor ⊗	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter ⊗	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate ⊗	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85651N	2	1	
U24	IC, CMOS, standard memory interface ⊗	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree ⊗	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2 input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch ⊗	412742	12040	MM74C173N	1	1	

Table 612-5. Digital Output PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	1		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		
	Socket, IC, 14 pin DTL	276527	91506	314-AG39D	2		

Table 612-6. Interface Cable Assemblies

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	**ASR33 INTERFACE CABLE ASSEMBLY (2200A-4406) Figure 612-5**	378349	89536	378349	REF		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
3	**TI SILENT 700 INTERFACE CABLE ASSEMBLY (2200A-4409) Figure 612-6**	430785	89536	430785	REF		
P1	Connector	312579	31746	DB-25S	1		
	Hood, strain relief	436642	31746	DB-51226-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
4	**RS-232 INTERFACE CABLE ASSEMBLY (2200A-4408) Figure 612-7**	433045	89536	433045	REF		
P1	Connector	312587	31746	DB-25F	1		
	Hood, P1, strain relief	436642	31746	DB-51226-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		


J18
50
26
R10
R9
R11
R19
R25
R20
R21
C1
VR1
Q1
C4
R15
U36
R12
U37
U35
P28
U31
U32
U33
U34
R17
K1
R4
R3
C3
C2
R2
R16
R13
U25
U26
U27
C5
U28
U29
U30
R8
R7
R6
R5
R24
R23
R1
R26
U24
U18
U19
U20
U21
U22
U23
TP2
R14
U16
U11
U12
U13
U14
U15
R27
U17
R18
U9
U10
CR28
CR27
CR3
CR4
CR5
CR6
CR11
CR12
CR13
CR14
CR19
CR20
CR21
CR22
U4
U5
U6
U7
U8
U1
U2
TP1
TP3
CR7
CR8
CR9
CR10
CR15
CR16
CR17
CR18
CR23
CR24
CR25
CR26

2200A–1614

Figure 612-4. Digital Output PCB Assembly

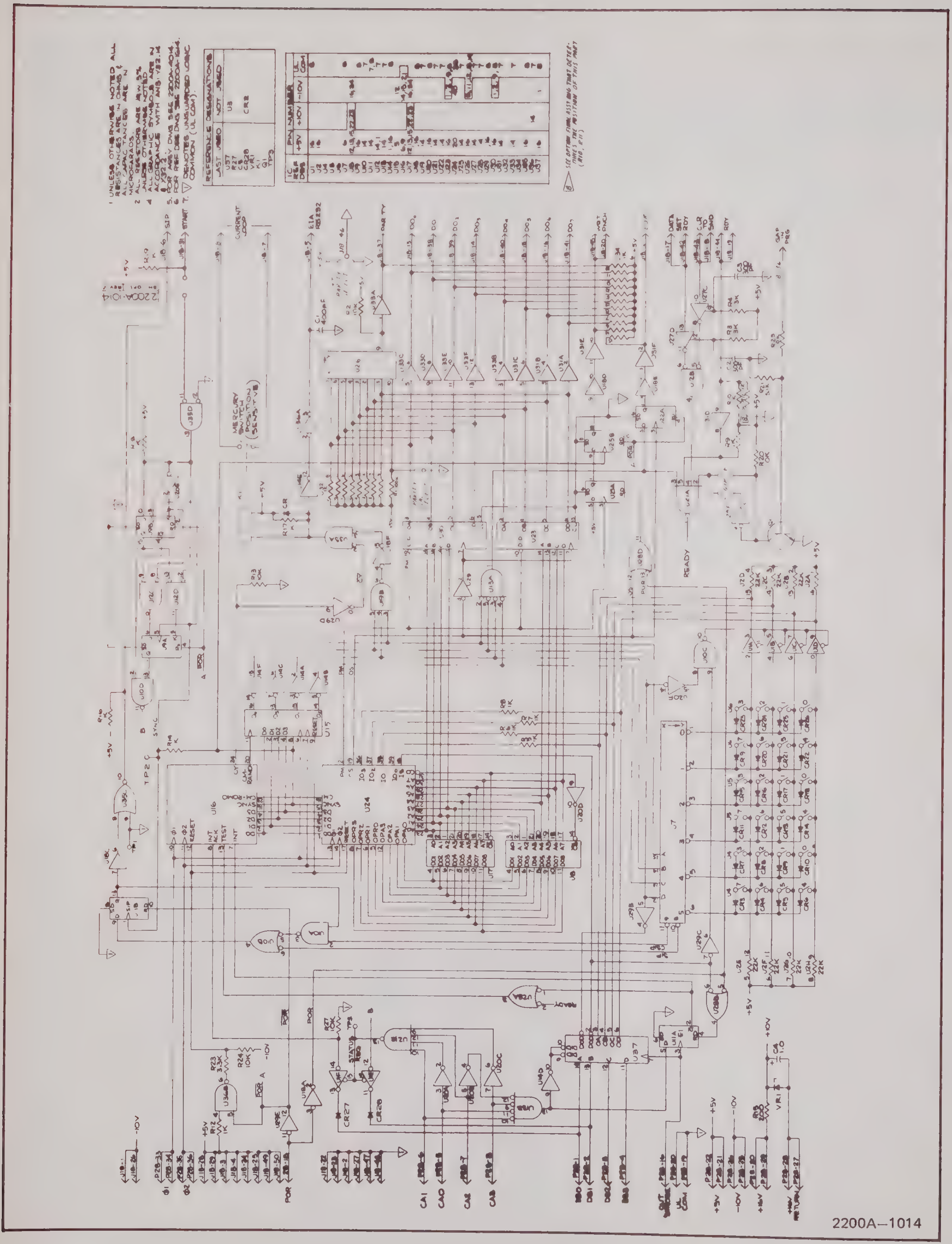
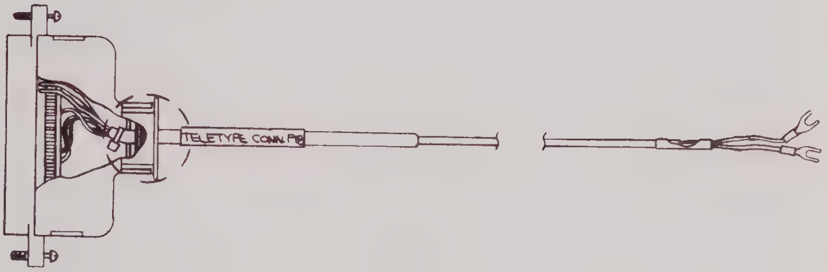


Figure 612-4. Digital Output PCB Assembly (cont)

WIRE LIST	
FROM	TO
P18-1	
-2	
-3	
-4	
-5	
-6	▷1
-7	▷2
-8	▷2
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	
-21	
-22	
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	▷1
-32	
-33	
-34	
-35	
-36	
-37	
-38	
-39	
-40	
-41	
-42	
-43	
-44	
-45	
-46	
-47	
-48	▷1
-49	
P18-50	



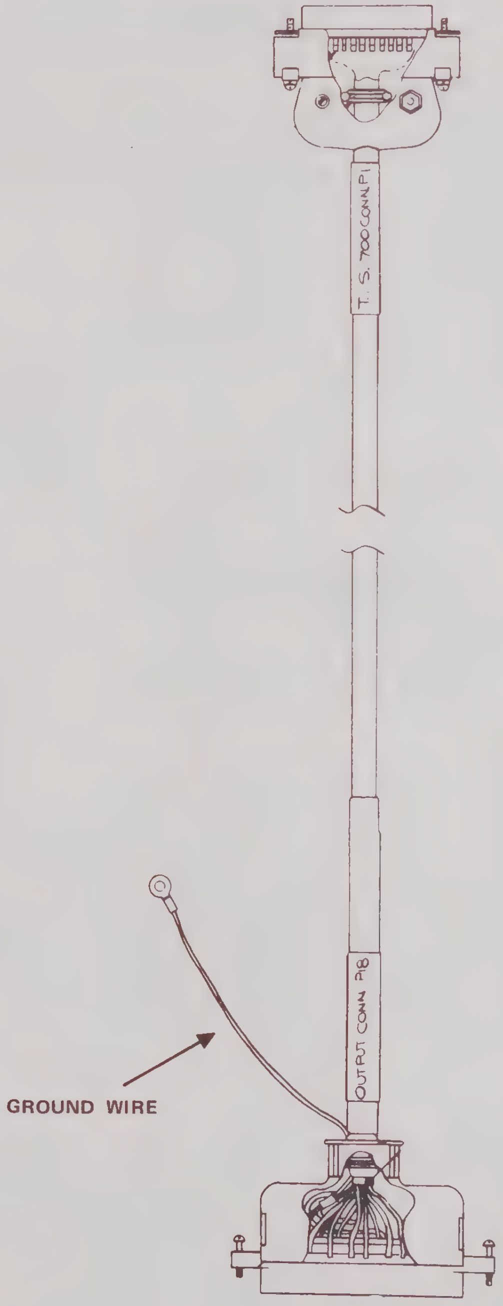
▷ Common connections to one I/O wire.

▷ Common connections to other I/O wire.

2200A–4406

Figure 612-5. ASR33 Interface Cable Assembly

WIRE LIST	
FROM	TO
P18-1	P1-5
-2	P1-7
-3	P1-6
-4	P1-8
-5	P1-3
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	
-18	
-19	
-20	
-21	
-22	
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	
-37	
-38	
-39	
-40	
-41	
-42	
-43	
-44	
-45	
-46	
-47	
-48	3
-49	
P18-50	

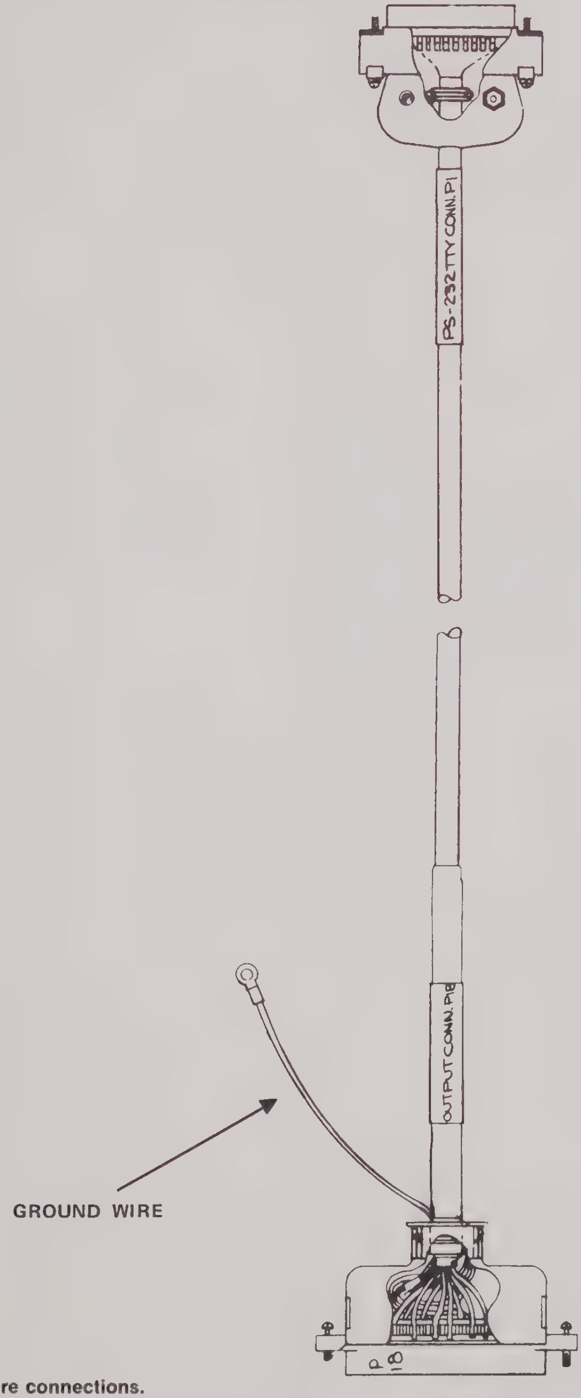

T. S. 700 CONN P1
OUTPUT CONN P18
GROUND WIRE

3 Common ground wire connections.

2200A—4409

Figure 612-6. T1 Silent 700 Interface Cable Assembly

WIRE LIST	
FROM	TO
P18-1	
-2	P1-7
-3	P1-4
-4	P1-20
-5	P1-2
-6	3▷
-7	
-8	
-9	
-10	
-11	
-12	
-13	
-14	
-15	
-16	
-17	P1-6
-18	P1-5
-19	
-20	
-21	
-22	
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3▷
-32	
-33	
-34	
-35	
-36	
-37	
-38	
-39	
-40	
-41	
42	
-43	
-44	
-45	
-46	
-47	
-48	3▷
-49	
P18-50	


RS-232 TTY CONN. P1
OUTPUT CONN. P18
GROUND WIRE
20

3▷ Common ground wire connections.

2200A—4408

Figure 612-7. RS-232 Interface Cable Assembly

—13 Series
Paper Tape Punch and Cassette Recorder Interface Options

613-1. SCOPE

613-2. The —13 Series Options include Options 13A through 13E, and are described in Section 1 of the data logger manual. Each option in the 13A through 13C series is compatible with the Facit Model 4070 Paper Tape Punch. Options 13C and 13D are compatible with Facits Model 4203.0005 Cassette Tape Recorder. The information contained herein deals with the Digital Output PCB used to interface these recording devices.

613-3. INTRODUCTION

613-4. The Digital Output PCB is designed to transfer character-serial/bit-parallel data from the data logger to either an external paper tape punch (Facit Model 4070) or an Incremented Interface Recorder. This includes: Time-of-Year (2240A), Fixed Data (2240A), Scan Counter (2200A), Digital Input Data (Option —16), and measurement data. The appropriate carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote start input.

613-5. A special interface cable and a series of 24 switches located on the pcb are used to tailor the pcb's digital output with the external recorder's digital inputs. The cable is included as part of the option and the user manually sets the switches to define the format of the recorded data. Provisions are included on the pcb for selecting either odd or even parity.

613-6. SPECIFICATIONS

613-7. Specifications for the —13 series of options are given in Table 613-1.

613-8. INSTALLATION

613-9. Digital Output PCB

613-10. Up to three Digital Output PCB's can be mounted in the data loggers I/O slots, as shown in Figure 613-1. Install each output pcb as follows:

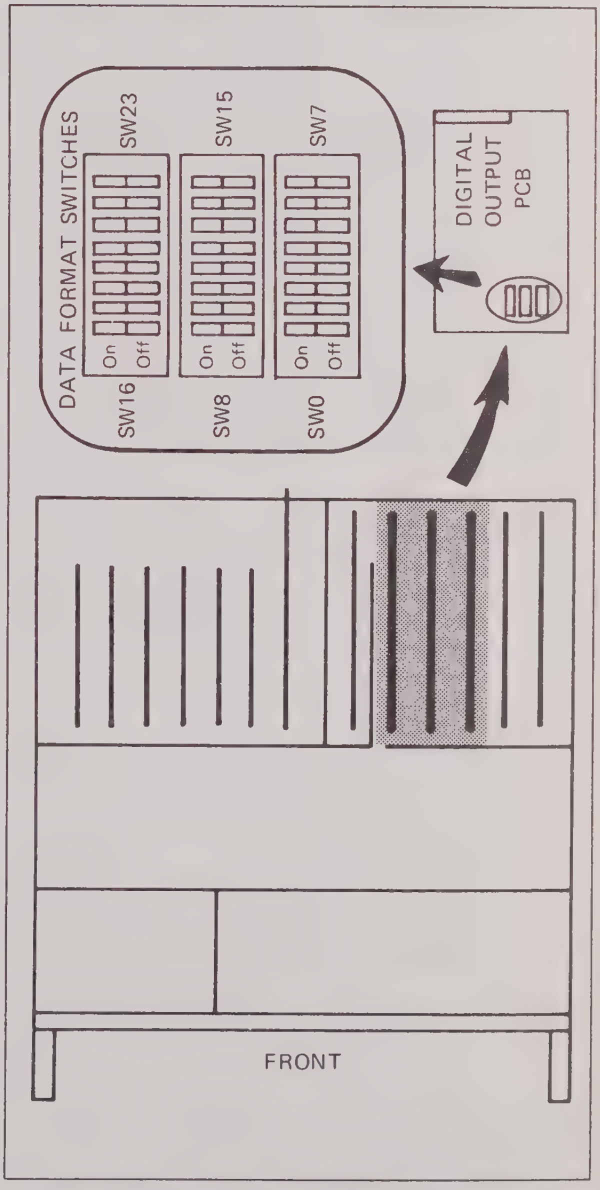


Figure 613-1. Digital Output PCB, Installation and Switch Locations

Table 613-1. —13 Series Options Specifications

Compatibility	Designed to interface the data logger output with the Facit Model 4203.0005. Specify requirements at time-of-purchase using alphabetic suffix as shown in Table 1-2.
Output Format	Character serial
Output Code	ASCII 8-level
Measurements per Line (—13A thru —13C)	1 thru 16, switch selectable.
Characters per Record (—13D thru —13E)	1 thru 2.56, switch selectable.
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed.
Record Format	@, CR, LF (Carriage Return, Line Feed) Time-of-Day (day, hr, min) CR, LF CR, LF, Fixed Data CR, LF Digital Inputs, CR, LF (—16 Option) Channels, limit, sign, data, range, function, CR, LF

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

a. Set the data loggers POWER switch to OFF.

b. Remove the top cover from the data logger.

c. Locate the Data Format switches on each Digital Output PCB as shown in Figure 613-1.

d. With reference to Figure 613-2, establish the format of recorded data as follows:

   1. Set switches 0 through 11 to OFF. This establishes the format shown in Figure 613-2.
   2. Delete any combination of unwanted character segments by setting the appropriate switches to ON.
   3. Refer to Figure 613-2 and set switches 12 through 15 for either the desired number of readings per line (paper tape punch interface) or the desired number of characters per record (incremental cassette tape recorder).
   4. Set unused switches (16 through 23 or 20 through 22) to OFF.

e. Refer to Figure 613-3 and position the jumpers desired odd or even parity.

f. Align the Digital Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.

g. After the Digital Output PCB(s) is (are) installed, install the top cover.

613-11. Interface Cable

613-12. The interface cable supplied with the —13 Series Option is designed to interface the Digital Output PCB with the specified recorder; Model 4070 Paper Tape Punch or Model 4203.0005 Cassette Tape Recorder. If the data logger scan sequences are to be manually initiated using the front panel SCAN CONTROL switches, connect the interface cable between the Digital Outptu PCB's rear-panel connector and the appropriate recording device. If the scan sequences are to be initiated by a remote input signal, complete the following procedure prior to connecting the interface cable.

a. Remove the hood from the 50-pin connector which mates with the Digital Output PCB.

b. Locate the three coiled wires stowed in the hood.

c. Uncoil the wires and identify each.

   1. Pin 31 — Start
   2. Pin 6 — Scan in Progress (SIP)
   3. Pin 48 — Logic Common

d. Feed the three wires through the cable port in the connector hood and reassemble the connector.

e. Install the interface cable and connect the remote control lines to the desired control source. The function of each line is described below:

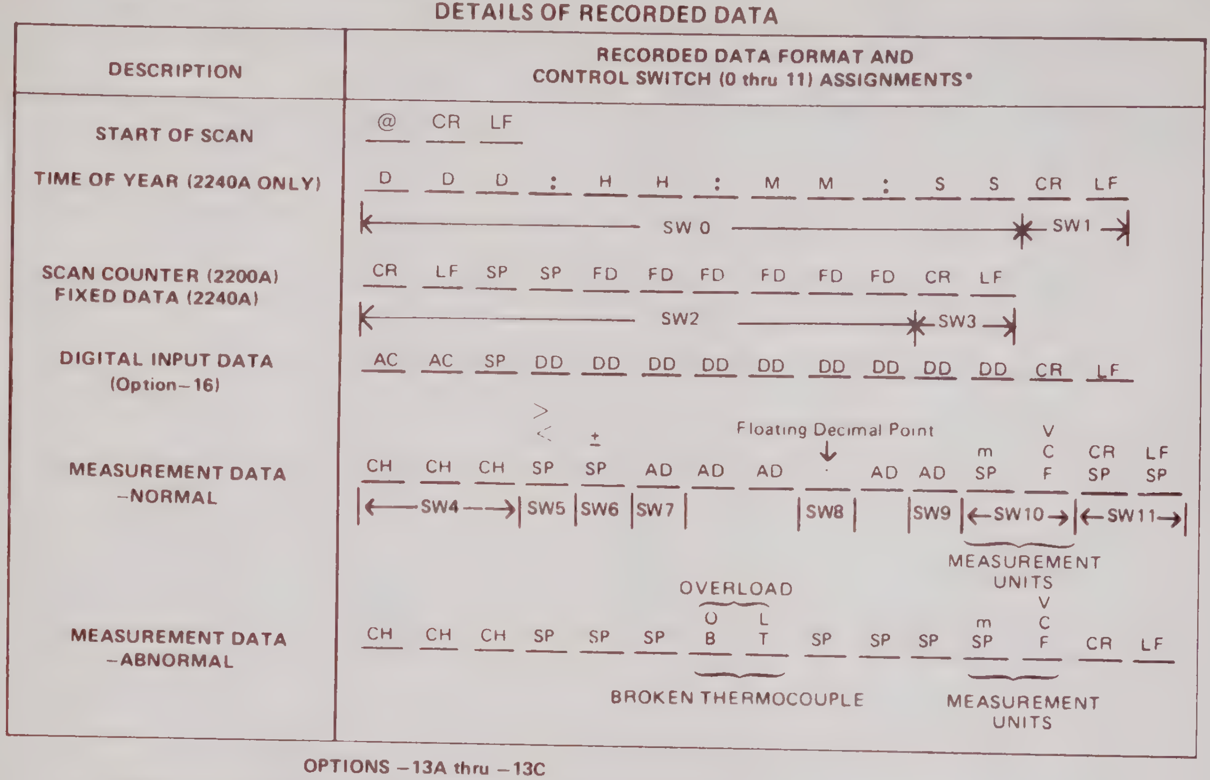
   1. START — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.
   2. SIP — A TTL output that goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.
   3. LOGIC COMMON — Logic common for the Start input and the SIP output signals.

NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

613-13. OPERATION

613-14. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given under Installation. Refer to the Facit Instruction Manual for details concerning the external recording device.


DETAILS OF RECORDED DATA
DESCRIPTION
RECORDED DATA FORMAT AND CONTROL SWITCH (0 thru 11) ASSIGNMENTS*
START OF SCAN
@ CR LF
TIME OF YEAR (2240A ONLY)
D D D : H H : M M : S S CR LF
SW 0
SW 1
SCAN COUNTER (2200A) FIXED DATA (2240A)
CR LF SP SP FD FD FD FD FD FD CR LF
SW2
SW3
DIGITAL INPUT DATA (Option–16)
AC AC SP DD DD DD DD DD DD DD DD DD CR LF
MEASUREMENT DATA –NORMAL
>
<
±
Floating Decimal Point
CH CH CH SP SP AD AD AD . AD AD m SP V C F CR SP LF SP
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
MEASUREMENT UNITS
MEASUREMENT DATA –ABNORMAL
OVERLOAD
CH CH CH SP SP SP O B L T SP SP SP m SP V C F CR LF
BROKEN THERMOCOUPLE
MEASUREMENT UNITS

OPTIONS –13A thru –13C

RECORDED MEASUREMENTS PER LINE SWITCH SETTINGS(12 thru 15)

Set switches to indicate, in binary, one less than the desired maximum number of recorded measurements per teleprinter line prior to CR LF. For example, 0000= one measurement recorded per teleprinter line. 1=ON

	NOT USED								SETTINGS INDICATE MEASUREMENTS PER LINE +1			
SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
BINARY EQUIVALENT	—	—	—	—	—	—	—	—	2^3	2^2	2^1	2^0
DECIMAL EQIVALENT	—	—	—	—	—	—	—	—	8	4	2	1

OPTIONS –13D and –13E

CHARACTERS PER RECORD SWITCH SETTINGS(12 thru 19)

Set switches to indicate, in binary, one less than the maximum number of recorded characters per scan sequence. For example, a binary coded 199 is equal to 200 recorded characters per scan sequence 1= ON

	NOT USED				SETTINGS INDICATE CHARACTERS PER RECORD +1							
SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
BINARY EQUIVALENT	—	—	—	—	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
DECIMAL EQIVALENT	—	—	—	—	128	64	32	16	8	4	2	1

***MNEMONICS**

AC = Address Code
AD = Analog Data
CH = Channel Number
CR = Carriage Return
D = Day Code
DD = Digital Input Data
FD = Fixed Data
H = Hours
LF = Line Feed
M = Minutes
S = Seconds
SP = Space

Figure 613-2. Recorded Data Format and Digital Output PCB Switch Assignments

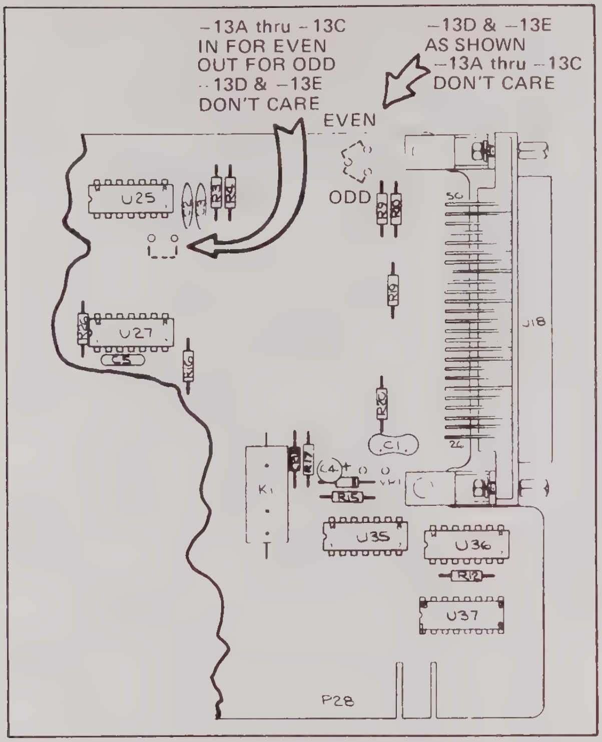


Figure 613-3. Even Parity Jumper Location, —13 Series Options

613-15. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed and an EXTERNAL ENABLE switch is depressed (preferrably ALL DATA) the folllowing conditions will assure a start of scan:

a. Apply a contact closure to ground or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input) allow the first scan squence to complete. SIP will return high at the end of the sequence, and will go low for subsequent scan sequences.

b. While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ⩾5 ms will cause a remote start.

c. Under worst case keyboard activity, a Start pulse, ⩾100 ms is required to ensure a remote start.

d. If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

613-16. THEORY OF OPERATION

613-17. The Digital Output PCB, as shown in Figure 613-4, is a microprocessor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day, digital data, heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accomodated by the interface. Among these are: a 20 mA current-loop telprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined, the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interfce cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they apply to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) and SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

613-18. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

613-19. When the Controller is ready to initiate a data transfer, it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 613-2 lists the possible responses and their meanings.

Table 613-2. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

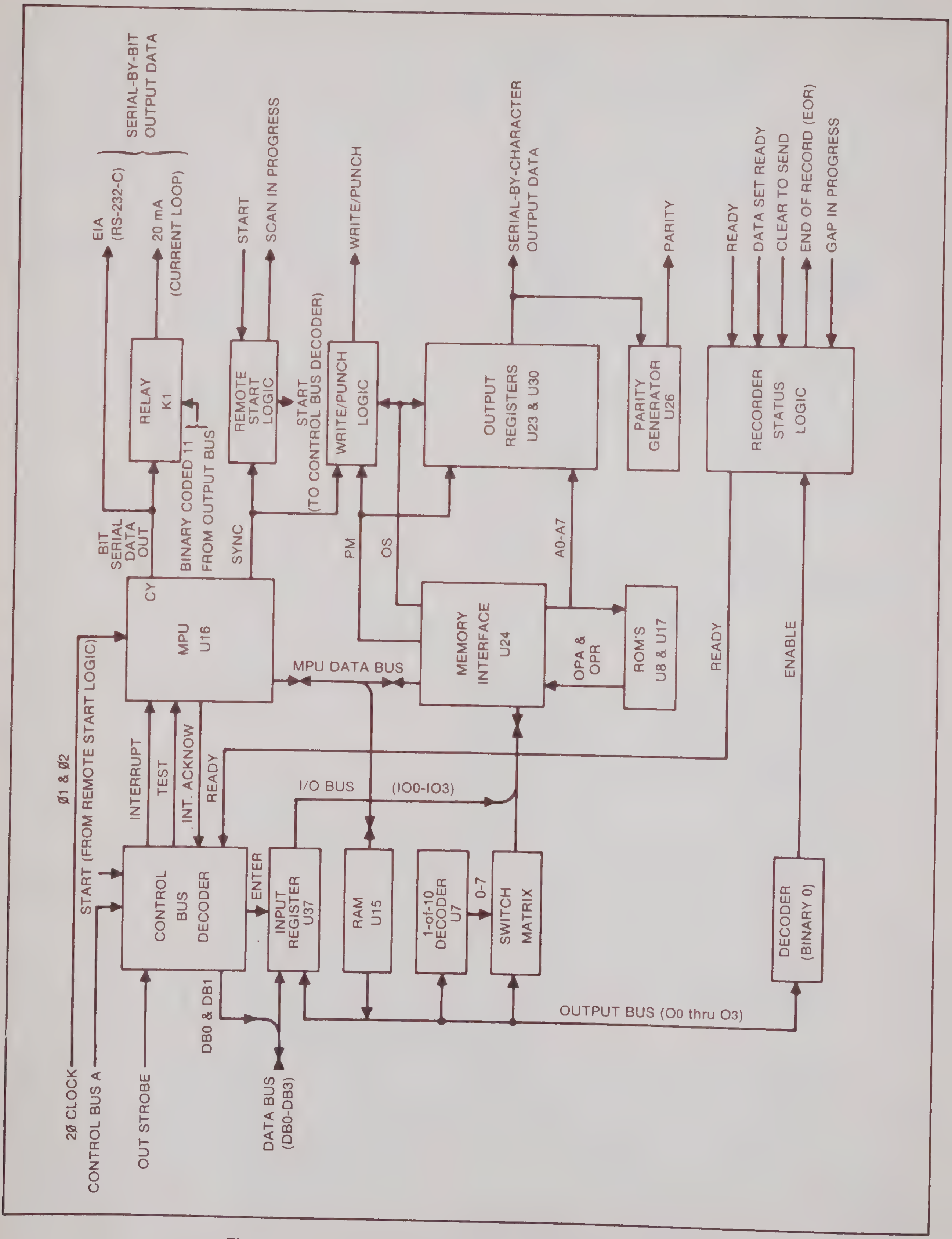

EIA
(RS-232-C)
20 mA
(CURRENT LOOP)
SERIAL-BY-BIT
OUTPUT DATA
START
SCAN IN PROGRESS
WRITE/PUNCH
SERIAL-BY-CHARACTER
OUTPUT DATA
PARITY
READY
DATA SET READY
CLEAR TO SEND
END OF RECORD (EOR)
GAP IN PROGRESS
RELAY
K1
REMOTE
START
LOGIC
START
(TO CONTROL BUS DECODER)
WRITE/PUNCH
LOGIC
OUTPUT
REGISTERS
U23 & U30
PARITY
GENERATOR
U26
RECORDER
STATUS
LOGIC
BIT
SERIAL
DATA
OUT
BINARY CODED 11
FROM OUTPUT BUS
SYNC
PM
OS
A0-A7
CY
MPU
U16
MEMORY
INTERFACE
U24
OPA &
OPR
ROM'S
U8 & U17
READY
ENABLE
MPU DATA BUS
Ø1 & Ø2
START (FROM REMOTE START LOGIC)
INTERRUPT
TEST
INT. ACKNOW
READY
I/O BUS
(IO0-IO3)
CONTROL
BUS
DECODER
ENTER
INPUT
REGISTER
U37
RAM
U15
1-of-10
DECODER
U7
0-7
SWITCH
MATRIX
DECODER
(BINARY 0)
2Ø CLOCK
CONTROL BUS A
OUT STROBE
DB0 & DB1
DATA BUS
(DB0-DB3)
OUTPUT BUS (O0 thru O3)

Figure 613-4. Digital Output PCB Simplified Block Diagram

613-20. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto bontrol Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an interrupt to the MPU and an input-Enable to the 4-bit input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered into the Input Register. As a result of the high Interrupt and Test inputs the MPU generates a low Interrupt Ackknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral devices, see Table 613-3). At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

613-21. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

613-22. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

613-23 The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output data in a bit-serial-by-character format, as well as, a bit-parallel-by-character format, each process will be considered separately.

613-24. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write/Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is issued, and the write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

613-25. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

613-26. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 613-4). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus)and read into the memory Interfce as six 4-bit characters. To read each character the MPU causes the RAM to sequentially lace binary coded numbers 0 through 5 onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches.) As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

613-27. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs/outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

613-28. The Remote Start Logic, upon receipt of an external Start command, alters the Digital Output PCB's status response so as to initiate a data logger scan sequence (see Table 613-2. An acceptable start input is a ≥5 ms contact closure to ground while the Scan-in-Progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan 9bainary coded 9) character with the normal data transfer characters. These two characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

613-29. MAINTENANCE

613-30. Access Information

613-31. Refer to the installation instructions given earlier in paragraph 613-8 for Digital Output PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

613-32. Performance Test

613-33. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

613-34. LIST OF REPLACEABLE PARTS

613-35. The lists of replaceable parts for the -14 series of data logger options are given in Tables 613-3, -4, and -5. Refer to Section 5 of the data logger manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 613-3. —13 Options Final Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, –13 SERIES OPTIONS						
–13A	**FACIT 4070 (BENCH TOP) AND INTERFACE** 1, 2, 4, 5, 6 ▷1				1		
–13B	**FACIT 4070 (RACK MOUNT) AND INTERFACE** 1, 2, 4, 5, 7 ▷1				1		
–13C	**FACIT 4070 INTERFACE** 1, 2, 4, 5 ▷1				1		
–13D	**FACIT 4203.0005 AND INTERFACE** 1, 3, 4, 5, 8 ▷1				1		
–13E	**FACIT 4203.0005 INTERFACE** 1, 3, 4, 5 ▷1				1		
▷1	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 613-4.	409524	89536	409524	1		
2	Paper Tape Punch Interface Cable Assembly. See Table 613-5.	377531	89536	377531	1		
3	Facit 4203.0005 Interface Cable Assembly. See Table 613-5.	449694	89536	449694	1		
4	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
5	Jumper, plug-in (10 pack)	373316	89536	373316	1		
6	Paper Tape Punch, bench top, Facit 4070-0004	435453	95011	4070-0004	1		
7	Paper Tape Punch, rack mount, Facit 4070-0024	435461	95011	4070-0024	1		
8	Cassette Tape Recorder, Facit 4203.0005	446732	95011	4203.0005	1		

Table 613-4. Digital Output PCB Assembly (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	**DIGITAL OUTPUT PCB ASSEMBLY, OPTION –13 (2200A-4014) Figure 613-5**	409524	89536	409524	REF		
C1	Cap, mica, 400 pF ±1%, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF ±10%, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μF ±20%, 20V	330662	56289	196D106X0020-KA1	1		
C5	Cap, cer, 0.68 μF -20/+80%, 25V	179077	56289	5C023684D8250-B3	1		
CR1, CR3 thru CR28	Diode, Si, switching	203332	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k ±5%, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k ±5%, 1/4W	148106	01121	DB1035	6		
R3, R4, R26	Res, comp, 13k ±5%, 1/4W	221598	01121	CB1335	3		
R5 thru R10, R12, R14, R16, thru R19	Res, comp, 1k ±5%, 1/4W	148023	01121	CB1025	12		
R15	Res, comp, 200 ±5%, 1/4W	193482	01121	CB2015	1		
R23	Res, comp, 3.3k ±5%, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer ⊗	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 613-4. Digital Output PCB Assembly (Continued)

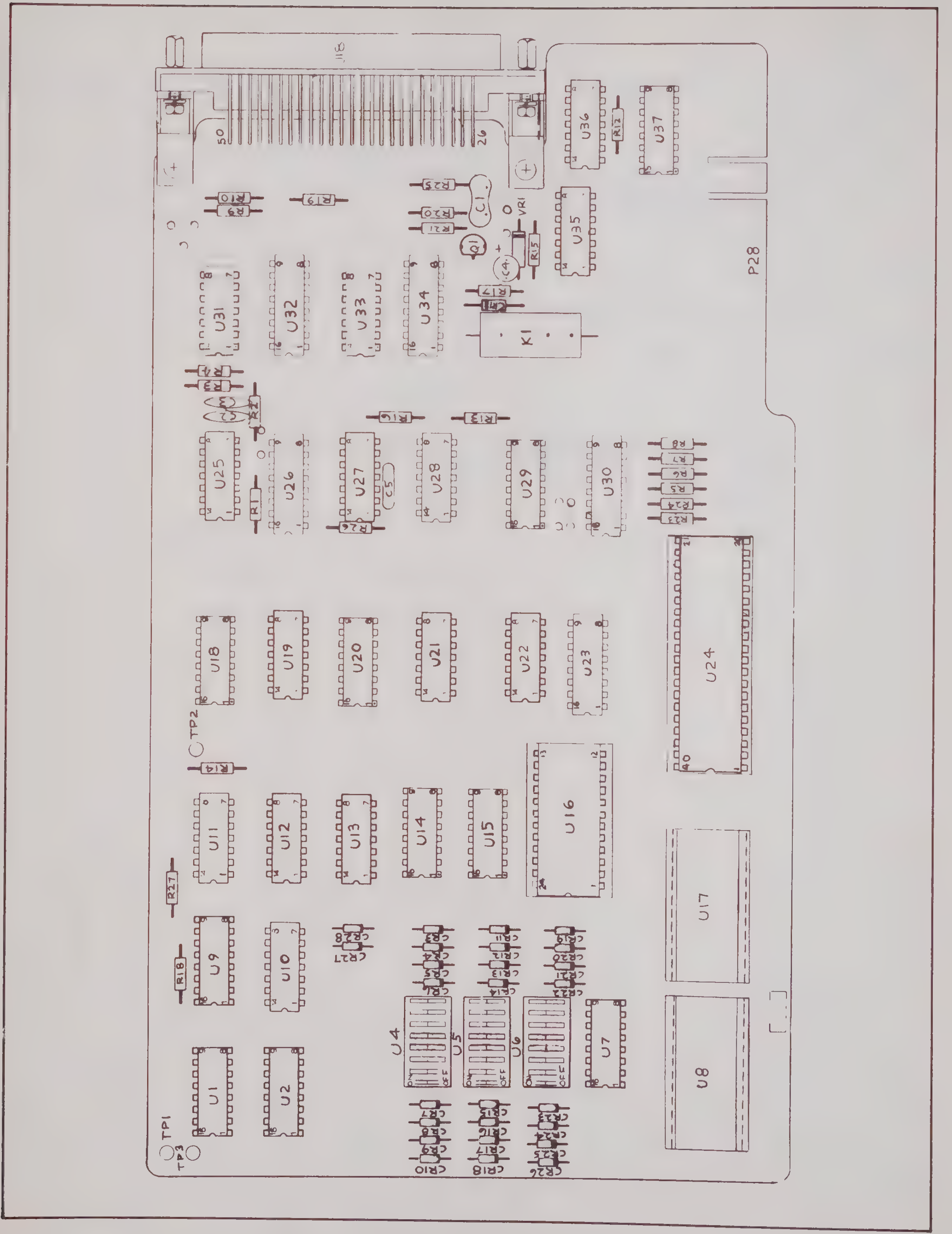
REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder ⊗	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop ⊗	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop ⊗	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate ⊗	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter ⊗	355214	04713	MC14009CP	3	1	
U15	IC, PMOS, 320 bit RAM and 4-bit output port ⊗	404442	34649	P4002-1	1	1	
U16	IC, MOS, central processor ⊗	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter ⊗	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate ⊗	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85L51N	2	1	
U24	IC, CMOS, standard memory interface ⊗	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree ⊗	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U31, U33	IC, TTL, hex buffer/driver with open	328021	01295	SN7417N	2	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2-input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch ⊗	412742	12040	MM74C173N	1	1	

Table 613-4. Digital Output PCB Assembly (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	1		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		

Table 613-5. Interface Cable Assemblies.

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	**PAPER TAPE PUNCH INTERFACE CABLE ASSEMBLY (2200A-4403) Figure 613-6**	377531	89536	377531	REF		
P1	Connector	312587	31746	DB-25F	1		
	Hood, strain relief, right angle	352385	31746	DB51213-1	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		
3	**FACIT 4203.0005 INTERFACE CABLE ASSEMBLY (2200A-4410) Figure 613-7**	449694	89536	449694	REF		
P1	Connector Assembly	446971	95011	15.080.790.00	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		


J18
50
26
P28
K1
VR1
Q1
C1
C4
C5
TP1
TP2
TP3
U1
U2
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
U19
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R20
R21
R23
R24
R25
R26
R27
CR7
CR8
CR9
CR10
CR11
CR12
CR13
CR14
CR15
CR16
CR17
CR18
CR19
CR20
CR21
CR22
CR23
CR24
CR25
CR26
CR27
CR28

Figure 613-5. Digital Output Interface PCB Assembly (2200A-1014) (Sheet 1 of 2)

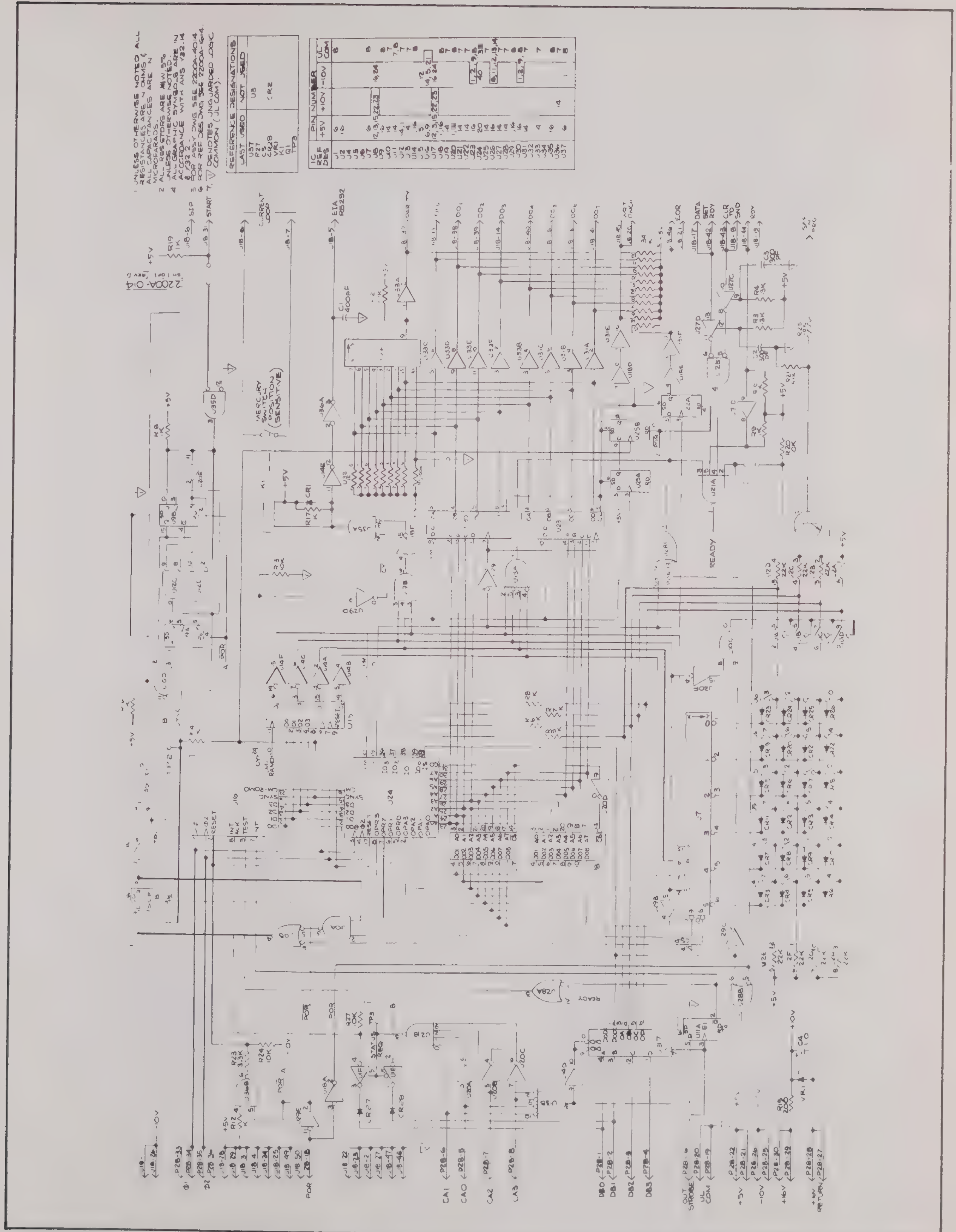
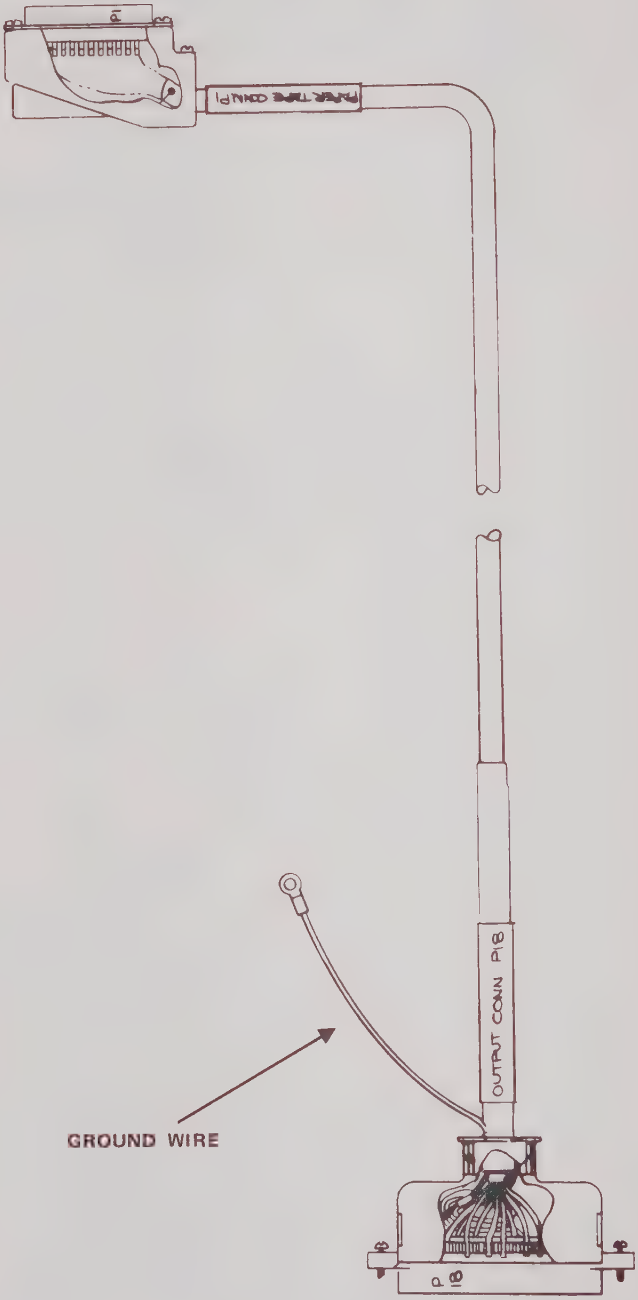

2200A-014
EIA RS232
CURRENT LOOP
MERCURY SWITCH (POSITION SENSITIVE)
READY
DATA SET RDY
CLR TO SND
STATUS REG
REFERENCE DESIGNATIONS
LAST USED
NOT USED
IC REF DES
PIN NUMBER
+5V
+10V
-10V
UL COM
CA1
CA0
CA2
CA3
DB0
DB1
DB2
DB3
OUT STROBE
UL COM
+5V
-10V
+16V
+16V RETURN
POR

Figure 613-5. Digital Output Interface PCB Assembly (2200A-1014) (Sheet 2 of 2)

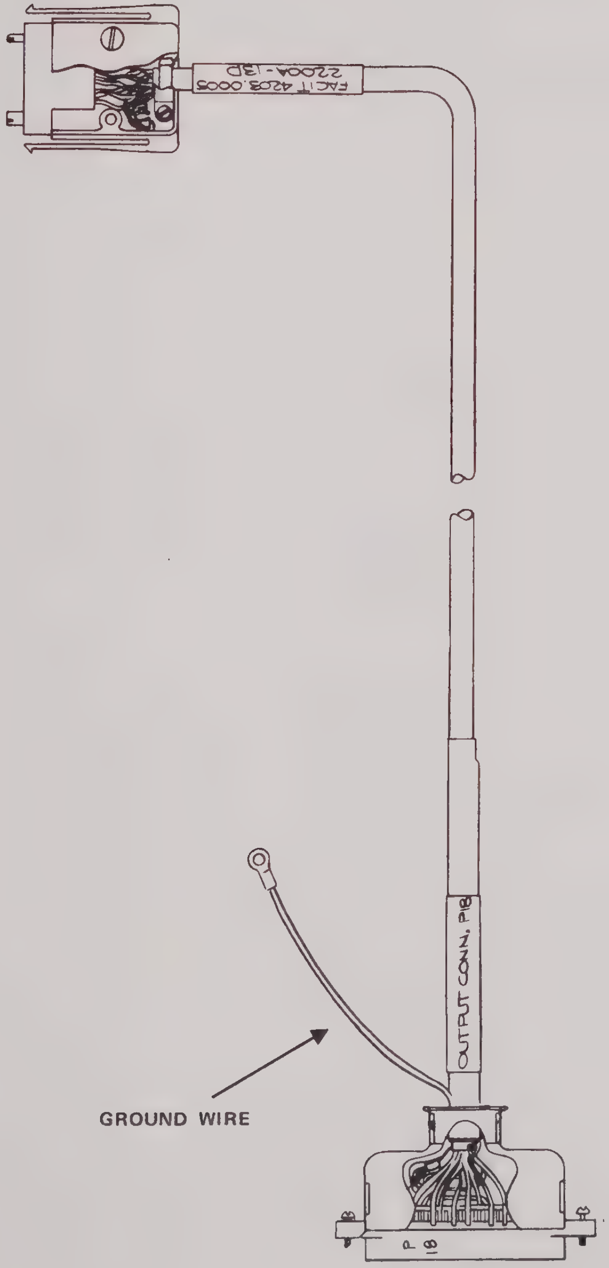
WIRE LIST	
FROM	TO
P18-1	
-2	P1-25
-3	P1-9
-4	
-5	
-6	3▷
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-1
-14	P1-4
-15	P1-6
-16	P1-7
-17	
-18	
-19	P1-12
-20	P1-11
-21	
-22	P1-10
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3▷
-32	
-33	
-34	
-35	
-36	
-37	P1-8
-38	P1-2
-39	P1-3
-40	P1-5
-41	
-42	
-43	
-44	
-45	
-46	
-47	
-48	3▷
-49	
P18-50	


P1
PAPER TAPE CONN P1
OUTPUT CONN P18
GROUND WIRE
P18

3▷ **Common ground wire connections**

Figure 613-6. Paper Tape Punch Interface Cable Assembly (2200A-4403)

WIRE LIST	
FROM	TO
P18-1	
-2	P1-A
-3	P1-D
-4	
-5	
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-M
-14	P1-R
-15	P1-T
-16	P1-U
-17	
-18	
-19	P1-E
-20	P1-F
-21	
-22	P1-B
-23	
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	
-37	P1-L
-38	P1-N
-39	P1-P
-40	P1-S
-41	P1-J
-42	
-43	
-44	
-45	
-46	
-47	P1-V
-48	3
-49	
P18-50	


FACIT 4203.0005
2200A-13D
OUTPUT CONN. P18
GROUND WIRE
P18

3 Common ground wire connections

Figure 613-7. Facit 4203.0005 Interface Cable Assembly (2200A-4410)

—14 Series
Magnetic Tape Interface Options

614-1. SCOPE

614-2. The —14 Series Options include Options —14A through —14K, and are described in Table 614-1. Each option in the series is compatible with a Kennedy Magnetic Tape Recorder. The information contained herein deals with the basic Digital Output PCB used to interface these recorders.

614-3. INTRODUCTION

614-4. The Digital Output PCB is designed to transfer character-serial/bit-parallel data from the data logger to an external Kennedy Magnetic Tape Recorder. This includes: Time-of-Year (2240B), Fixed Data (2240B), Scan Counter (2200A), Digital Input Data (Option —16), and measurment data. The appropriate carriage-return and line-feed characters are also generated. Provisions are included for initiating a scan sequence using a remote Start input.

614-5. A unique interface cable and a series of 24 switches on the pcb are used to tailor the digital output with the recorder. The cable is included as part of the option. The switches are set by the user to define baud rate and data format.

614-6. The Digital Output PCB transfers ASCII, BCDIC and EBCDIC coded characters to the recorder, along with a write pulse. On some units odd or even parity can be selected by positioning a jumper wire on the pcb. On others, it is fixed at odd parity by the recorder. The pcb is shipped from the factory with the odd parity jumper installed.

Table 614-1. Configuration of –14 Option

OPTION NO	DESCRIPTION	TRACKS *	PARITY (ODD/EVEN)	OPTION COMPONENTS (INDICATED BY ●)		
				PCB	CABLE	RECORDER
–14A	Kennedy 1600/5 and Interface	7	Selectable	●	●	●
–14B	Kennedy 1610/5 and Interface	7	Selectable	●	●	●
–14C	Kennedy 1600/360 and Interface	9	Odd	●	●	●
–14D	Kennedy 1610/360 and Interface	9	Odd	●	●	●
–14E	Kennedy 1600/5 or 1610/5 Interface	7	Selectable	●	●	
–14G	Kennedy 1600/360 or 1610/360 Interface	9	Odd	●	●	
–14H	Kennedy 9832–7 and Interface	7	Selectable	●	●	●
–14I	Kennedy 9832–7 Interface	7	Selectable	●	●	
–14J	Kennedy 9832–9 and Interface	9	Odd	●	●	●
–14K	Kennedy 9832–9 Interface	9	Odd	●	●	

** 7 track = BCDIC or ASCII*
9 track = EBCDIC or ASCII

614-7. After a preset number of characters (switch selectable) have been transferred to the recorder, the Digital Output PCB generates an Inter-Record Gap (IRG) command. The recorder responds by generating a standard IRG and returning a Gap-In-Progress signal to inhibit a data transfer during the IRG generation. If the scan mode is changed before the specified number of characters have been transferred, the Digital Output PCB will insert a $ character into the record until the character count is satisfied.

614-8. SPECIFICATIONS

614-9. Specifications for the 14 Series of options are given in Table 614-2.

614-10. INSTALLATION

614-11. Digital Output PCB

614-12. Up to three Digital Output PCB's can be mounted in the data logger's I/O slots, as shown in Figure 614-1. Install each —14 Series pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

Table 614-2. —14 Series Options Specifications

Compatibility	Specify at time-of-purchase using alphabetic suffix as shown in Table 614-1
Output Format	Character serial
Output Levels	TTL compatible (positive true)
Output Code	BCDIC, EBCDIC or ASCII
Record Format	@CR, LF (Carriage Return, Line Feed) Time-of-Day (day, hr., min., s) CR, LF CR, LF, Fixed Data CR, LF Digital Inputs, CR, LF (—16 Option) Channels, limit, sign, data, function, CR, LF
Word Format	Unwanted word blocks may be deleted by switches on pcb. Word order cannot be changed.
Physical Record Length	Fixed. 1 to 4096 characters, switch selectable on pcb.

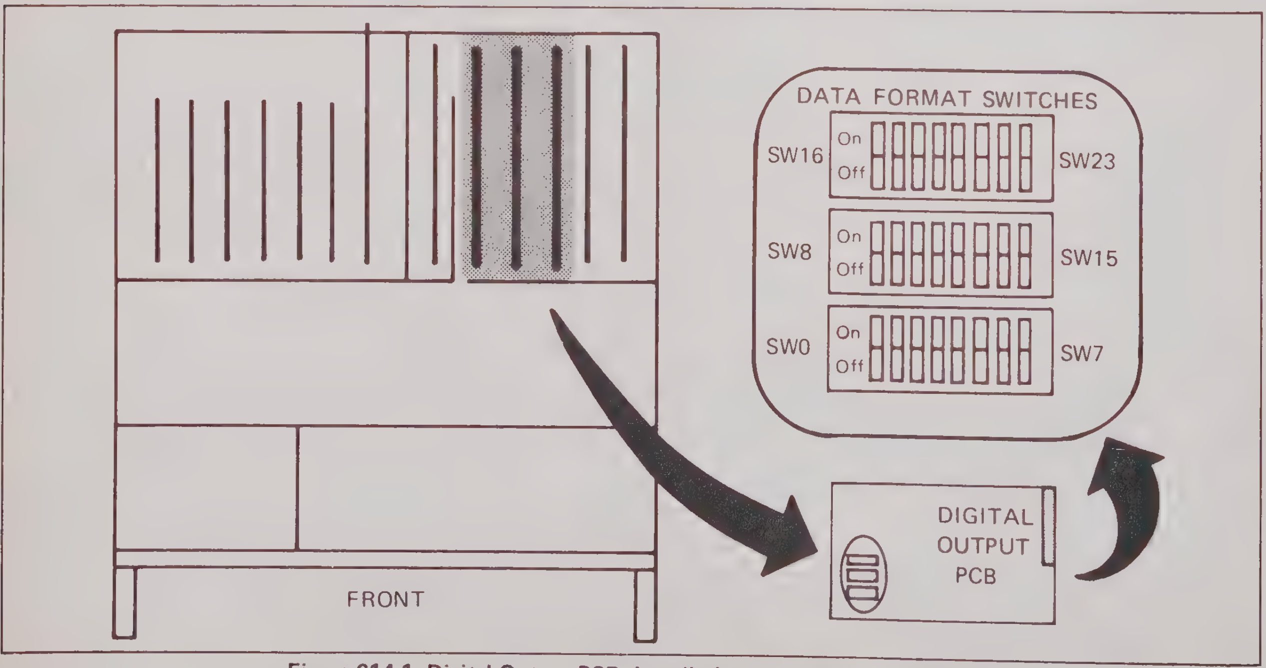


Figure 614-1. Digital Output PCB, Installation and Switch Locations

a. Set the data loggers POWER switch to OFF.

b. Remove the top cover from the data logger.

c. Locate the Data Format switches on each —14 Series Digital Output PCB, as shown in Figure 614-1.

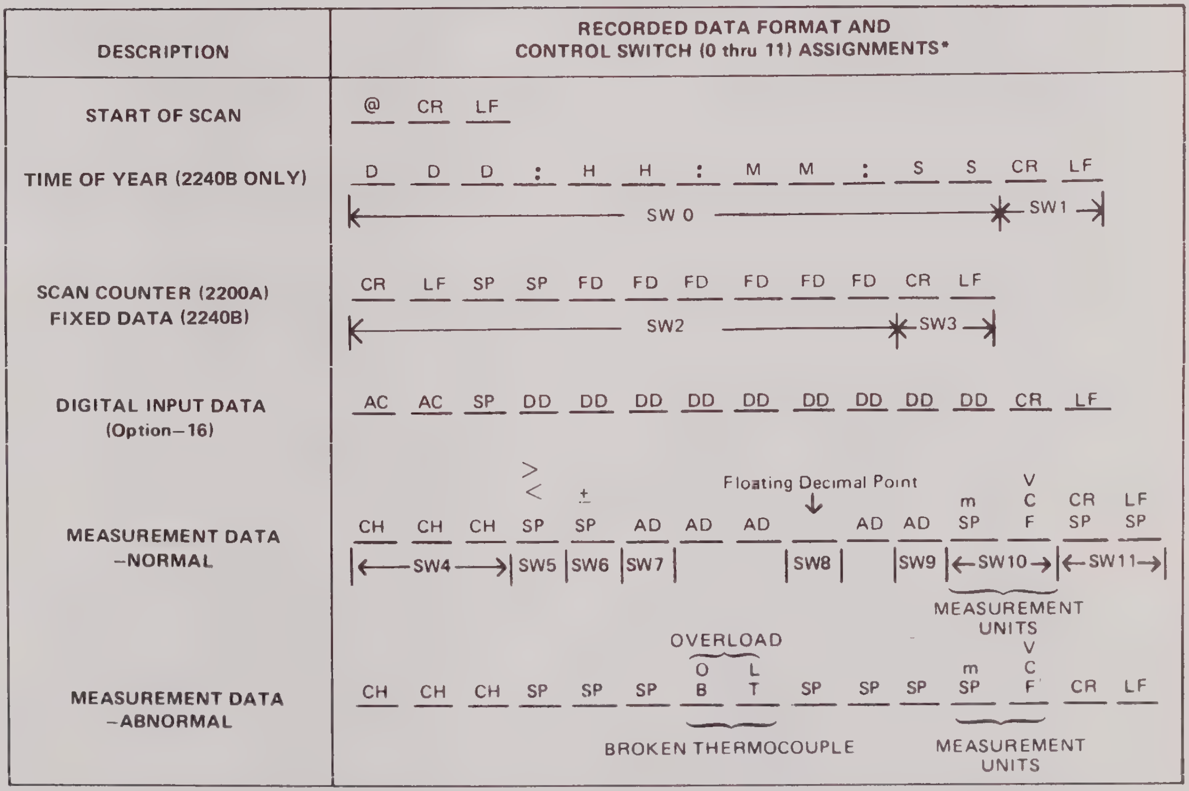
d. With reference to Figure 614-2, establish the format of recorded data as follows:

1. Set switches 0 through 23 to OFF. This establishes the format shown in Figure 614-2.

2. Delete any combination of unwanted character segments by setting the appropriate switches to ON.

3. Set switches 12 through 23 to indicate (in binary) one less than the maximum

DETAILS OF RECORDED DATA


DESCRIPTION
RECORDED DATA FORMAT AND CONTROL SWITCH (0 thru 11) ASSIGNMENTS*
START OF SCAN
@ CR LF
TIME OF YEAR (2240B ONLY)
D D D : H H : M M : S S CR LF
SW 0
SW1
SCAN COUNTER (2200A)
FIXED DATA (2240B)
CR LF SP SP FD FD FD FD FD FD CR LF
SW2
SW3
DIGITAL INPUT DATA (Option—16)
AC AC SP DD DD DD DD DD DD DD DD DD CR LF
MEASUREMENT DATA —NORMAL
Floating Decimal Point
CH CH CH > < SP ± SP AD AD AD AD AD m SP V C F CR SP LF SP
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
MEASUREMENT UNITS
MEASUREMENT DATA —ABNORMAL
OVERLOAD
CH CH CH SP SP SP O B L T SP SP SP m SP V C F CR LF
BROKEN THERMOCOUPLE
MEASUREMENT UNITS

CHARACTERS PER RECORD SWITCH SETTINGS (12 thru 23)

Set switches to indicate, in binary, one less than the maximum number of recorded characters per record. For example a binary coded 499 is equal to 500 recorded characters per record.

SETTINGS INDICATE CHARACTERS PER RECORD +1

SWITCHES	20	21	22	23	16	17	18	19	12	13	14	15
BINARY EQUIVALENT	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
DECIMAL EQIVALENT	2048	1024	512	256	128	64	32	16	8	4	2	1

*MNEMONICS

AC = Address Code
AD = Analog Data
CH = Channel Number
CR = Carriage Return
D = Day Code
DD = Digital Input Data
FD = Fixed Data
H = Hours
LF = Line Feed
M = Minutes
S = Seconds
SP = Space

Figure 614-2. Recorded Data Format and Digital Output PCB Switch Assignments

number of characters to be recorded during a scan sequence. One (binary coded zero) to 4096 (binary coded 4095) characters can be selected (1 = ON).

e. Refer to Figure 614-3 and check to ensure that the parity jumper is properly positioned. If necessary, reposition the jumper to obtain the desired odd or even parity.

f. Align the Digital Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.

g. After the Digital Output PCB(s) is (are) installed, install the top cover.

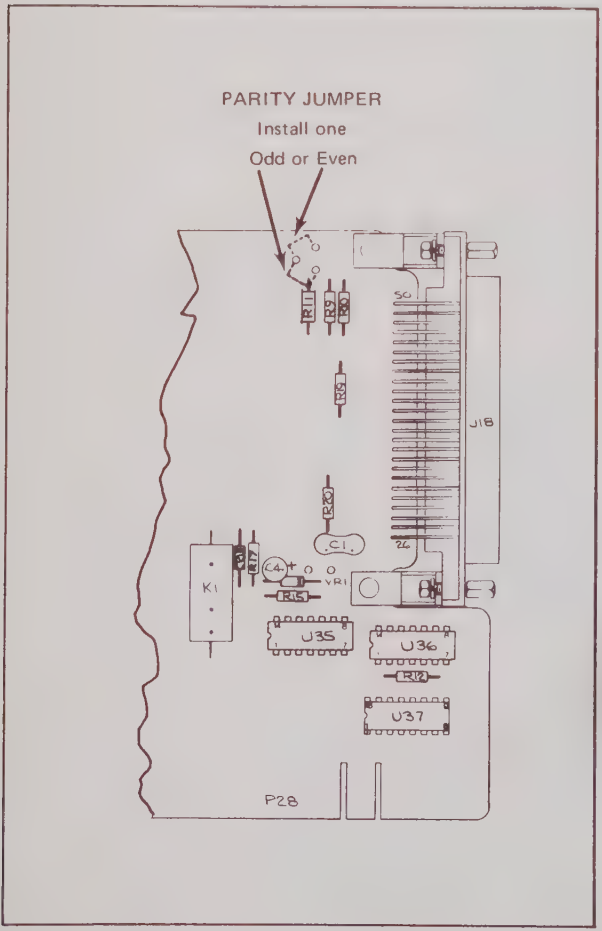


Figure 614-3. Parity Jumper Location, —14 Series Options

614-13. Interface Cable

614-4. The interface cable supplied with the —14 Series Options is designed to connect the Digital Output PCB to the appropriate Kennedy Magnetic Tape Recorder. If the data logger scan sequences are to be manually initiated using the front-panel switches, connect the interface cable between the Digital Output PCB's rear-panel connector and the tape recorder. If the scan sequence is to be initiated by a remote input, complete the following procedure prior to connecting the interface cable:

a. Remove the hood from the 50-pin connector that mates with the Digital Output PCB.

b. Locate the three coiled wires stowed in the hood.

c. Uncoil the wires and identify each prior to reassembling the connector.

1. Pin 31 — Start
2. Pin 6 — Scan in Progress (SIP)
3. Pin 48 — Logic Common

d. Install the interface cable and connect the remote control lines to the desired control source. The function of each line is described below:

1. START — If the REMOTE switch in the data logger's SCAN CONTROL switch group is depressed, a contact closure to Logic Common or a low TTL/DTL logic level will initiate a scan sequence. If a scan is in progress, the Start input is ignored.

2. SIP — A TTL output that goes low to indicate that a scan is in progress. Start inputs during this period are ignored. SIP also goes low when REMOTE is pressed, and will remain low until an external START is received and the first scan sequence is completed.

3. LOGIC COMMON — Logic common for the Start input and the SIP output signals.

NOTE

If a single remote control source is used and more than one Digital Output PCB is installed, it is sufficient to complete the remote control connections on only one interface cable.

614-15. OPERATION

614-16. Once installed in the data logger, the Digital Output PCB requires no operator attention. Instructions for connecting the remote control lines are given earlier under the installation. Refer to the appropriate Kennedy Instruction Manual for details concerning the magnetic tape recorder.

614-17. The timing required to initiate a remote start depends upon the data logger's configuration and its current activities. Assuming that the REMOTE SCAN CONTROL switch is depressed the following conditions will assure a start of scan:

a. Apply a momentary contact closure to ground (48) or a low logic level to the Start input (31). If SIP (6) is initially low (prior to start input), allow the first scan sequence to complete. SIP will return high at the end of the sequence and will go low for subsequent scan sequences.

b. While the Scan in Progress output is high (i.e., no keyboard or front panel activity) a negative going Start pulse with a width of ⩾5 ms will cause a remote start.

c. Under worst case keyboard activity, a Start pulse ⩾100 ms is required to ensure a remote start.

d. If the Start input is held low from the start to finish of a scan sequence, a second scan will be initiated. A continuous scan mode is achieved by holding the Start input low.

614-18. THEORY OF OPERATION

614-19. The Digital Output PCB, as shown in Figure 614-4, is a microprocessor based subsystem which functions as a Controller peripheral to provide the interface necessary to transfer data logger time-of-day, digital data, heading and measurement data (as printed on the internal printer) to an external digital recording device. Any one of several types of recorders can be accommodated by the interface. Among these are: a 20 mA current-loop teleprinter, a paper tape punch, an incremental magnetic tape recorder, or any RS-232C compatible recording device. Once the recorder is defined the interface pcb can be tailored to meet the interface requirements by the addition of two plug-in ROM's and an interface cable (both are supplied as an integral part of the option). Additional formatting and baud rate requirements (when applicable) are manually selected using a series of 24 switches located on the pcb. (See Installation instructions for switch settings as they apply to this option.) Provisions are also included which allow a contact closure to ground (or any other low-level input) to serve as a remote start-of-scan signal to the data logger. While a scan is in progress (SIP) an SIP output is generated to indicate that subsequent start inputs will not be accepted until the current scan sequence has been completed.

614-20. Data transfer from the Controller to the external recorder is accomplished in two operations: first, an input transfer sequence, and then, an output transfer sequence. The input transfer sequence is executed under the direction of the Controller and includes the character-serial transfer of 16 four-bit characters from the Controller (via the Data Bus) to a storage location (RAM) on the Digital Output PCB. After the input transfer is complete, the microprocessor on the Digital Output PCB directs the execution of the output transfer sequence. That is, the transfer of data from the storage location to the recording device. Appropriate handshaking is employed to ensure the output transfer is synchronized with the recorder.

614-21. When the Controller is ready to initiate a data transfer it interrogates the status of the Digital Output PCB by placing a binary coded 6 onto Control Bus A. A decoder on the PCB detects the 6 and initiates an appropriate status response via the Data Bus. Table 614-3 lists the possible responses and their meanings.

614-22. Upon receiving a binary coded 3 (11) as a status response, the Controller initiates the data transfer sequence by simultaneously placing a binary coded 4 onto Control Bus A, and the first data character (4 bits) onto the Data Bus. A Control Bus Decoder detects the control character (binary coded 4) and responds by generating an Interrupt to the MPU and an input Enable to the 4-bit Input Register. On the rising edge of the accompanying Out Strobe the Test input to the MPU is driven high and the character on the Data Bus is entered into the Input Register. As a result of the high Interrupt and Test inputs, the MPU issues a low Interrupt Acknowledge output which is used to provide a Busy response. (Busy is used in the event the status of the output pcb is interrogated prior to completing the entire data transfer to the peripheral device see Table 614-3.) At the same time the MPU causes the output RAM to place a binary coded 8 onto the Output Bus. The presence of this code plus a subsequent IS pulse (generated by the Memory Interface) enables the contents of the Input Register to be read (via the I/O Bus) by the Memory Interface. On the trailing edge of the IS pulse the MPU's Test input is returned low to complete the first character segment of the 16-character input-transfer sequence.

Table 614-3. Description of Status Response Codes

Status Response		Meaning of Status Response
DB1	DB0	
0	0	Remote Start commanded but transfer in progress. Wait until not Busy.
0	1	Remote Start. Initiate a scan sequence.
1	0	Busy. Data transfer in progress. No action required.
1	1	Initiate a data transfer sequence.

614-23. Since the binary coded 4 is still present on the Control Bus, the character-serial transfer of data between the Controller and the Memory Interface continues, as previously described, until an entire block of 16 characters has been processed. As each character of input data is read by the System Interface it is also transferred through the MPU (via the MPU Data Bus) into the RAM.

614-24. After the Controller presents the last input character to the Digital Output PCB it removes the binary coded 4 from Control Bus A. With the control code gone the Interrupt input to the MPU goes low to inhibit additional data from being entered into the input register. This completes the initial phase (input data transfer) of the data transfer sequence.

614-25. The output transfer sequence begins as the MPU writes a binary coded 0 onto the Output Bus. A decoder detects the zero and issues an Enable input to the Recorder Status Logic. If the external device is ready to receive data, the Recorder Status Logic will provide a low Ready output which drives the MPU's test input high to indicate that an output transfer may commence. Since the Digital Output PCB is capable of transferring output data in a bit-serial-by-character format, as well as, a bit-parallel-by-charcter format, each process will be considered separately.

614-26. Bit parallel output data is stored, one character at a time, in a pair of 4-bit output registers. Data transfer to the registers is enabled by the PM input from the Memory Interface, and is entered on the leading edge of the OS pulse. As PM goes low the first output character, including 4-bits of supplementary data (ASCII, BCDIC, and/or EBCDIC), is placed onto address lines A0 through A7. After the character is entered by the subsequent OS pulse, the PM output is returned high. This PM transition arms the Write/Punch Logic to allow the rising edge of the next Sync pulse to initiate a Write/Punch output pulse. An appropriate amount of time later a second OS pulse is issued, and the write/punch output is terminated on the trailing edge of the next Sync pulse. As each bit-parallel character appears on the output lines (D0 through D7) a Parity Generator provides a ninth bit (jumper selectable odd or even) for parity.

614-27. The bit serial output is enabled when the MPU instructs the RAM to place a binary coded 11 onto the Output Bus. Output data is then taken a bit at a time from the MPU's CY output and used to drive an EIA output buffer as well as relay K1. The mercury-wetted contacts of K1 are used to provide a current loop interface (contact closure for a 20 mA current loop).

614-28. The format of output data is established by the setting of 24 rocker switches which comprise a 3 x 8 switch matrix (see Figure 614-4). These switches are scanned at the beginning of each output transfer sequence by the MPU (via the RAM Output Bus) and read into the Memory Interface as six 4-bit characters. To read each character the MPU causes the RAM to sequentially place binary coded numbers 0 through 5 onto the Output Bus. A 1-of-10 decoder detects each number, and effectively scans the matrix switches in groups of four. Thus, each closed switch within a scanned group causes a low level to be placed onto the normally high I/O Bus. (Isolation diodes are provided with each switch to avoid interaction between the various groups of matrix switches). As each four-bit word appears on the I/O Bus, it is read into the Memory Interface (by an IS pulse).

614-29. The transfer of output data, regardless of format, must be synchronized with the interfaced recorder. This is accomplished by the Recorder Status Logic which detects and reacts to a series of handshaking routines. For example, Ready and Punch inputs, outputs are used to synchronize the operation to a paper tape punch. Similarly, RS-232C compatible recorders employ the Data-Set-Ready and Clear-to-Send inputs. Magnetic tape recorders utilize the Ready and Write lines to record data, and the EOR (end-of-record) and Gap-in-Progress lines to initiate (EOR) a standard inter-record gap, and to indicate its duration (Gap-in-Progress).

614-30. The Remote Start Logic, upon receipt of an external start command, alters the Digital Output PCB's status response so as to initiate a data logger scan sequence (see Table 614-3). An acceptable start input is a ≥5 ms contact closure to ground while the scan-in-progress output is high. When the Controller interrogates the status of the Digital Output PCB (binary coded 6 on Control Bus A) the Remote Start Logic provides a start scan response via the Control Bus Decoder. During the following data transfer sequence the Controller includes both a start-of-scan (binary coded 8) and an end-of-scan (binary coded 9) character with the normal data transfer characters. These two characters are decoded by the 1-of-10 decoder, and used to initiate and terminate the Scan-in-Progress (SIP) output. While the SIP output is active all start inputs are ignored.

614-31. MAINTENANCE

614-32. Access Information

614-33. Refer to the installation instructions given earlier in paragraph 614-11 for Digital Output PCB access information. Remove the rear-panel output connector before attempting to remove the pcb from the data logger.

614-34. Performance Test

614-35. The Digital Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and interfaced with the recording device it normally drives. Output data format and characters can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

614-36. LIST OF REPLACEABLE PARTS

614-37. The lists of replaceable parts for the 14 Series of data logger options are given in Tables 614-4, -5, and -6. Refer to Section 5 of the data logger manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

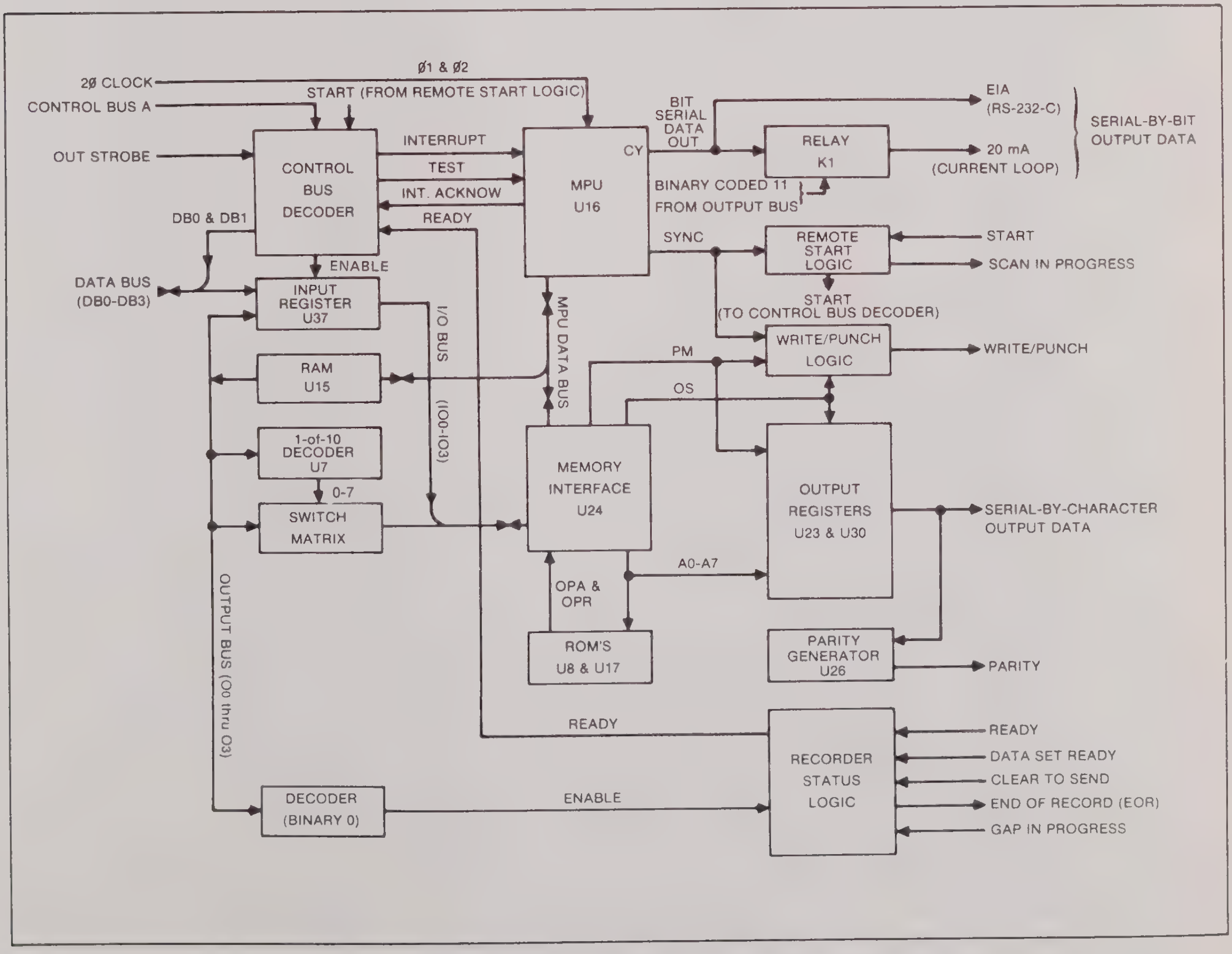

2Ø CLOCK
CONTROL BUS A
Ø1 & Ø2
START (FROM REMOTE START LOGIC)
OUT STROBE
CONTROL BUS DECODER
INTERRUPT
TEST
INT. ACKNOW
READY
MPU U16
CY
BIT SERIAL DATA OUT
RELAY K1
EIA (RS-232-C)
20 mA (CURRENT LOOP)
SERIAL-BY-BIT OUTPUT DATA
BINARY CODED 11 FROM OUTPUT BUS
DB0 & DB1
DATA BUS (DB0-DB3)
ENABLE
INPUT REGISTER U37
SYNC
REMOTE START LOGIC
START
SCAN IN PROGRESS
START (TO CONTROL BUS DECODER)
I/O BUS (IO0-IO3)
MPU DATA BUS
RAM U15
PM
WRITE/PUNCH LOGIC
WRITE/PUNCH
OS
1-of-10 DECODER U7
0-7
SWITCH MATRIX
MEMORY INTERFACE U24
OUTPUT REGISTERS U23 & U30
SERIAL-BY-CHARACTER OUTPUT DATA
A0-A7
OPA & OPR
ROM'S U8 & U17
PARITY GENERATOR U26
PARITY
OUTPUT BUS (O0 thru O3)
READY
RECORDER STATUS LOGIC
READY
DATA SET READY
CLEAR TO SEND
END OF RECORD (EOR)
GAP IN PROGRESS
DECODER (BINARY 0)
ENABLE

Figure 614-4. Digital Output PCB Simplified Block Diagram

Table 614-4. Final Assembly, –14 Series Options

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY, –14 SERIES OPTIONS						
14A	KENNEDY 1600/5 AND INTERFACE 1, 2, 3, 4, 5, 13, 15 [1]				1		
14B	KENNEDY 1610/5 AND INTERFACE 1, 2, 3, 4, 6, 13, 15 [1]				1		
–14C	KENNEDY 1600/360 AND INTERFACE 1,2, 3, 4, 7, 13, 15 [1]				1		
–14D	KENNEDY 1610/360 AND INTERFACE 1, 2, 3, 4, 8, 13, 15 [1]				1		
–14E	KENNEDY 1600/5 or 1610/5 INTERFACE 1, 2, 3, 4, 13, 15 [1]				1		
–14G	KENNEDY 1600/360 or 1610/360 INTERFACE 1, 2, 3, 4, 13, 15 [1]				1		
–14H	KENNEDY 9832-7 AND INTERFACE 1, 3, 4, 9, 11, 14, 15 [1]				1		
–14I	KENNEDY 9832-7 INTERFACE 1, 3, 4, 11, 14, 15 [1]				1		
–14J	KENNEDY 9832-9 AND INTERFACE 1, 3, 4, 10, 12, 14, 15 [1]				1		
–14K	KENNEDY 9832-9 INTERFACE 1, 3, 4, 12, 14, 15 [1]				1		

Table 614-4. Final Assembly, –14 Series Options (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
▷1	Subassembly item numbers. Descriptions are as follows:						
1	Digital Output PCB Assembly. See Table 614-5	409524	89536	409524	1		
2	Magnetic Tape Interface Cable Assembly. See Table 614-6	377556	89536	377556	1		
3	IC, PROM, special program, U8 and U17 (Provide interface description and U number when ordering replacement.)	432757	89536	432757	2		
4	Jumper, plug-in (10 pack)	373316	89536	373316	1		
5	Tape Recorder, Kennedy 1600/5	435479	89536	435479	1		
6	Tape Recorder, Kennedy 1610/5	435487	89536	435487	1		
7	Tape Recorder, Kennedy 1600/360	435495	89536	435495	1		
8	Tape Recorder, Kennedy 1610/360	431296	89536	431296	1		
9	Tape Recorder, Kennedy 9832-7	461764	89536	413464	1		
10	Tape Recorder, Kennedy 9832-9	413468	89536	413468	1		
11	Magnetic Tape Interface Cable Assembly. See Table 614-6.	471367	89536	471367	1		
12	Magnetic Tape Interface Cable Assembly, See Table 614-6.	471359	89536	471359	1		
13	IC, TTL, hex buffer/driver with open collector (U31 and U33)	328021	01295	SN7417N	2		
14	IC, TTL, Hex inverter/buffer (U31 and U33)	288605	01295	SN7416N	2		
15	Res, comp, 1k ± 5%, 1/4 W (R10 or R11)	148023	01121	CB1025	1		

Table 614-5. Digital Output PCB Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	DIGITAL OUTPUT PCB ASSEMBLY, (2200A-4014) **Figure 614-5**	409524	89536	409524	REF		
C1	Cap, mica, 400 pF ±1%, 500V	385328	72136	DM15F401F	1		
C2, C3	Cap, cer, 300 pF ±10%, 500V	105734	71590	BB60301KW7W	2		
C4	Cap, Ta, 10 μF ±20%, 20V	330662	56289	196D106X0020-KA1	1		
C5	Cap, cer, 0.68 μF -20/+80%, 25V	179077	56289	5C023684D8250-B3	1		
CR1, CR3, thru CR28	Diode, Si, switching	203323	07910	1N4448	27	6	
J18	Connector, female, 50 pin	414417	00779	552130-1	1		
K1	Relay, reed	357509	71707	UF-40066	1		
Q1	Xstr, Si, NPN	218396	04713	2N3904	1	1	
R1	Res, comp, 100k ±5%, 1/4W	148189	01121	CB1045	1		
R2, R13, R20, R24, R25, R27	Res, comp, 10k ±5%, 1/4W	148106	01121	CB1035	6		
R3, R4, R26	Res, comp, 13k ±5%, 1/4W	221598	01121	CB1335	3		
R5 thru R9, R12, R14, R16 thru R19	Res, comp, 1k ±5%, 1/4W	148023	01121	CB1025	11		
R15	Res, comp, 200 ±5%, 1/4W	193482	01121	CB2015	1		
R21	Res, comp, 5.1k ±5%, 1/4W	193342	01121	CB5125	1		
R23	Res, comp, 3.3k ±5%, 1/4W	148056	01121	CB3325	1		
U1	IC, CMOS, hex buffer ⊗	407759	12040	MM80C97N	1	1	
U2	Res, network	376962	89536	376962	1	1	
U4, U5, U6	Switch Assembly, DIL, 8-position, spdt	414490	00779	435166-5	3	1	

Table 614-5. Digital Output PCB Assembly (cont)

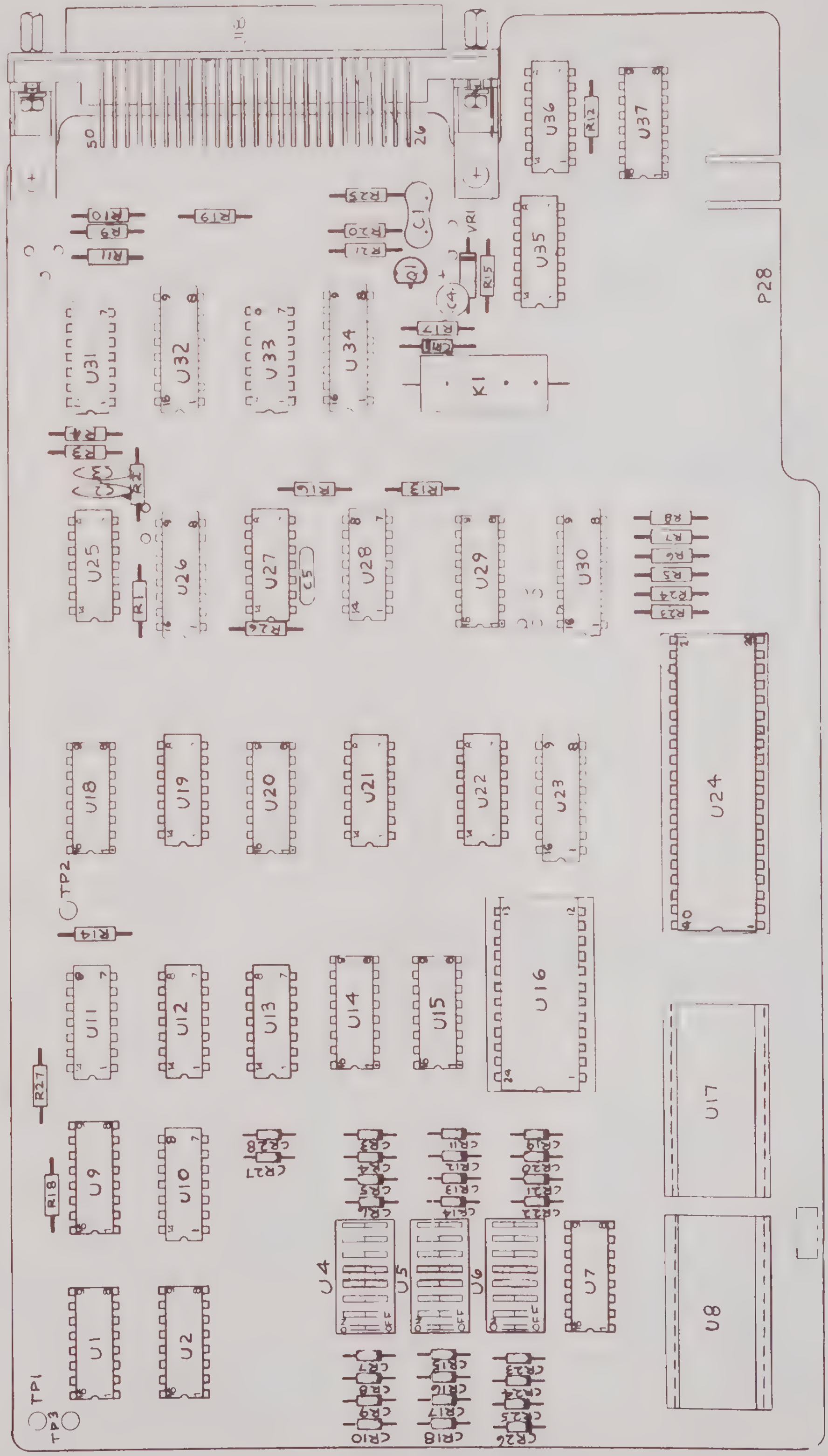
REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U7	IC, CMOS, bcd-to-decimal decoder ⊗	407981	12040	MM74C42N	1	1	
U9	IC, CMOS, dual J-K flip flop ⊗	355230	04713	MC14027CP	1	1	
U10, U28	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	2	1	
U11, U22, U25	IC, CMOS, dual D-type flip flop ⊗	340117	04713	MC14013CL	3	1	
U12	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	1	1	
U13	IC, CMOS, dual 4-input NOR gate ⊗	363820	04713	MC14002CP	1	1	
U14, U20, U29	IC, CMOS, hex buffer/converter ⊗	355214	04713	MC14009CP	3	1	
U15	IC, PMOS, 320 bit RAM and 4-bit output port ⊗	404442	34649	P4002-1	1	1	
U16	IC, MOS, central processor ⊗	404418	34649	C4040	1	1	
U18	IC, CMOS, hex buffer/converter ⊗	355412	04713	MC14010CP	1	1	
U19	IC, CMOS, triple 3-input NAND gate ⊗	375147	04713	MC14023CP	1	1	
U21	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
U23, U30	IC, TTL, tri-state, quad D-type flip flop	408203	12040	DM85L51N	2	1	
U24	IC, CMOS, standard memory interface ⊗	404434	34649	P4289	1	1	
U26	IC, CMOS, 12-bit parity tree ⊗	414060	04713	MC14531CP	1	1	
U27	IC, quad line receiver	414045	12040	LM1489	1	1	
U32	Res, network	358119	89536	358119	1	1	
U34	Res, network	417469	89536	417469	1	1	
U35	IC, TTL, quad 2-input NOR buffer, open collectors	414037	01295	SN74LS33N	1	1	
U36	IC, quad line driver	414052	12040	LM1488	1	1	
U37	IC, CMOS, quad D-type latch ⊗	412742	12040	MM74C173N	1	1	

Table 614-5. Digital Output PCB Assembly (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
VR1	Diode, zener	340695	12969	UZ8710	1	1	
	Hardware Kit, connector	435750	00779	552565-1	1		
	Socket, IC, 24-pin DIL	418970	91506	324-AG39D	3		
	Socket, IC, 40-pin DIL	418988	91506	340-AG39D	1		
	Socket, 1 pin	376418	22526	75060-007	11		
	Socket, IC, 14 pin DIL	276527	91507	314-AG39D	2		

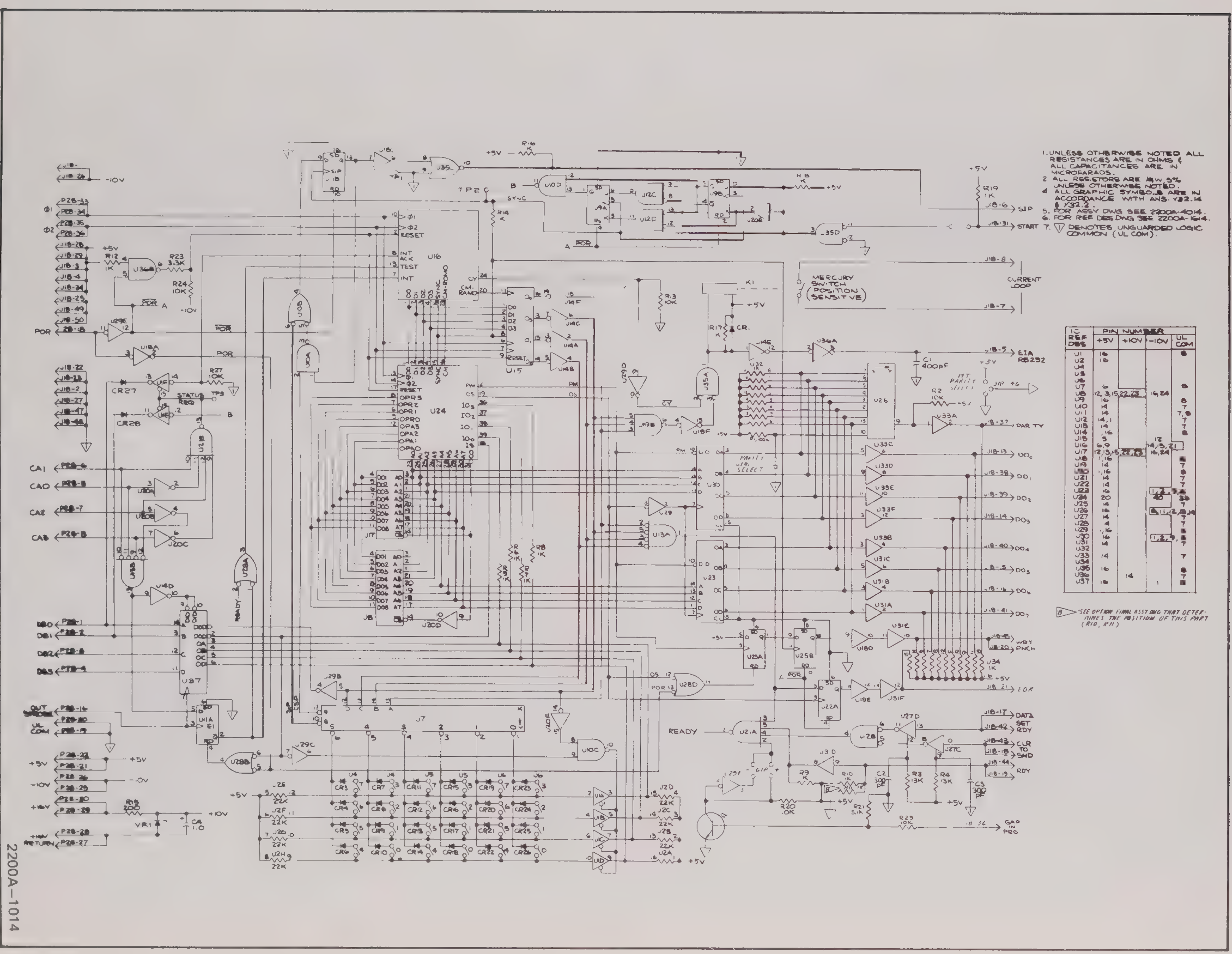
Table 614-6. Interface Cable Assembly

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
2	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A-4404) Figure 614-6	377556	89536	377556	REF		
P1	Connector with hood	158451	71785	57-30360	1		
P18	Connector, 50 pin	417386	00779	552390-1	1		
	Hood, P18, strain relief	386649	00779	552008-1	1		
11	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A–4411) Figure 614-7	471367	89536	471367	REF		
P1	Connector	235093	71785	DC37-P	1		
P18	Hood, strain relief	386755	71785	DC51214-1	1		
P18	Connector, 50-pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552009-1	1		
	Grommet, rubber	100065	83330	2174	2		
	ID, Cable, P18	428870	89536	428870	1		
	ID, Cable, P1	453112	89536	453112	1		
12	MAGNETIC TAPE INTERFACE CABLE ASSEMBLY (2200A-4412) Figure 614-8				REF		
P1	Connector	235093	71785	DC37-P	1		
	Hood, strain relief	386755	71785	DC51214-1	1		
P18	Connector, 50-pin	417386	00779	552390-1	1		
	Hood, strain relief	386649	00779	552008-1	1		
	Grommet, rubber	100065	83330	2174	2		
	ID, Cable, P18	428870	89536	428870	1		
	ID, Cable, P1	473009	89536	473009	1		


J18
50
26
U36
R12
U37
R25
C1
VR1
R10
R9
R11
R19
R20
R21
Q1
R15
C4
U35
P28
R17
CR1
U31
U32
U33
U34
K1
R4
R3
C3
R2
R16
R13
U25
U26
U27
C5
U28
U29
U30
R8
R7
R6
R5
R24
R23
R1
R26
U24
U18
U19
U20
U21
U22
U23
TP2
R14
U11
U12
U13
U14
U15
U16
R27
U17
R18
U9
U10
CR28
CR27
U4
U5
U6
U7
U8
U1
U2
TP1
TP3
CR10
CR18
CR26

2200A–1614

Figure 614-5. Digital Output PCB Assembly


Φ1
Φ2
POR
CA1
CA0
CA2
CA3
DB0
DB1
DB2
DB3
OUT STROBE
UL COM
+5V
-10V
+16V
+16V RETURN
U16
U24
U15
U37
U7
J7
J8
U30
U23
U26
TP2
SYNC
READY
MERCURY SWITCH (POSITION SENSITIVE)
CURRENT LOOP
SIP
START
EIA RS232
PARITY
DO0
DO1
DO2
DO3
DO4
DO5
DO6
DO7
WRT PNCH
EOR
DATA SET RDY
CLR TO SND
RDY
GAP IN PRG
STATUS RED
2200A–1014

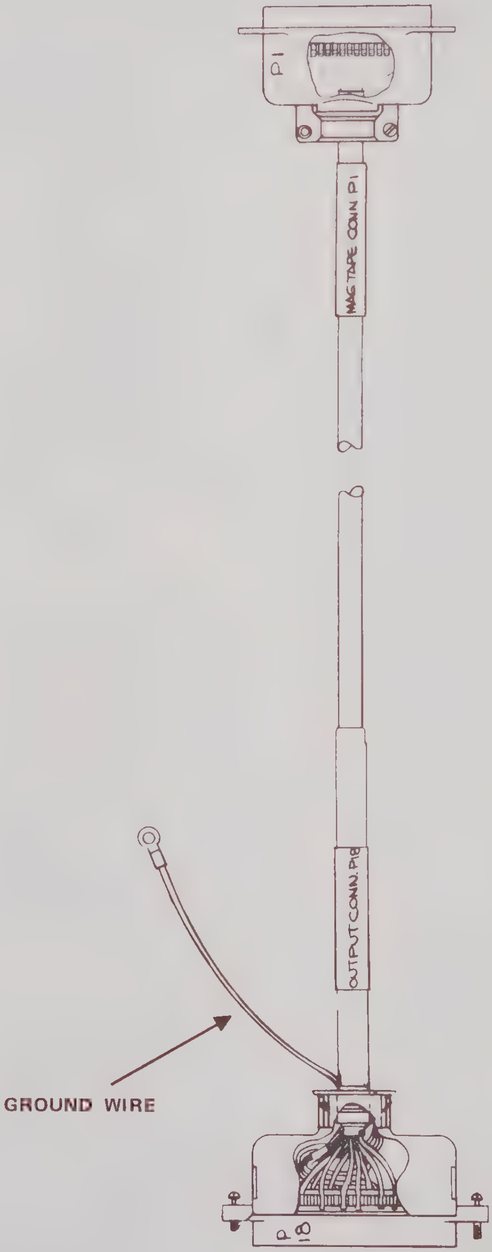
1. UNLESS OTHERWISE NOTED ALL RESISTANCES ARE IN OHMS & ALL CAPACITANCES ARE IN MICROFARADS.
2 ALL RESISTORS ARE ¼W 5% UNLESS OTHERWISE NOTED.
4 ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANS. Y32.14 & Y32.2.
5. FOR ASSY DWG SEE 2200A-4014.
6. FOR REF DES DWG SEE 2200A-1614.
7. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).

IC REF DES	PIN NUMBER			
	+5V	+10V	-10V	UL COM
U1	16			8
U2	16			
U4				
U5				
U6				
U7	6			8
U8	12, 3, 15	22, 23	16, 24	
U9	16			8
U10	14			7
U11	14			7, 8
U12	14, 1			7
U13	14			7
U14	, 16			8
U15	5		12	
U16	6, 9		14, 15, 21	
U17	12, 13, 15	22, 23	16, 24	
U18	1, 16			8
U19	14			7
[illegible]	1, 16			8
U21	14			7
U22	14			7
U23	16		1, 7, [illegible]	[illegible]
U24	20		40	[illegible]
U25	14			7
U26	16		8, 11, 12, 13, 14	
U27	14			7
U28	4			7
U29	1, 16			8
U30	16		1, 2, 9,	8
U31	14			7
U32				
U33	14			7
U34				
U35	16			8
U36		14		7
U37	16		1	8

8 SEE OPTION FINAL ASSY DWG THAT DETERMINES THE POSITION OF THIS PART (R10, R11)

Figure 614-5. Digital Output PCB Assembly (cont)

WIRE LIST	
FROM	TO
P18-	
-2	P1-29
-3	P1-1
-4	P1-3
-5	
-6	3▷
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-18
-14	P1-20
-15	P1-16
-16	P1-22
-17	
-18	
-19	P1-27
-20	P1-14
-21	P1-30
-22	P1-6&7
-23	
-24	
-25	
-26	
-27	P1-8&11
-28	P1-10
-29	
-30	
-31	3▷
-32	
-33	
-34	
-35	
-36	P1-28
-37	
-38	P1-19
-39	P1-17
-40	P1-21
-41	P1-23
-42	
-43	
-44	
-45	
-46	P1-13
-47	
-48	3▷
-49	
P18-50	

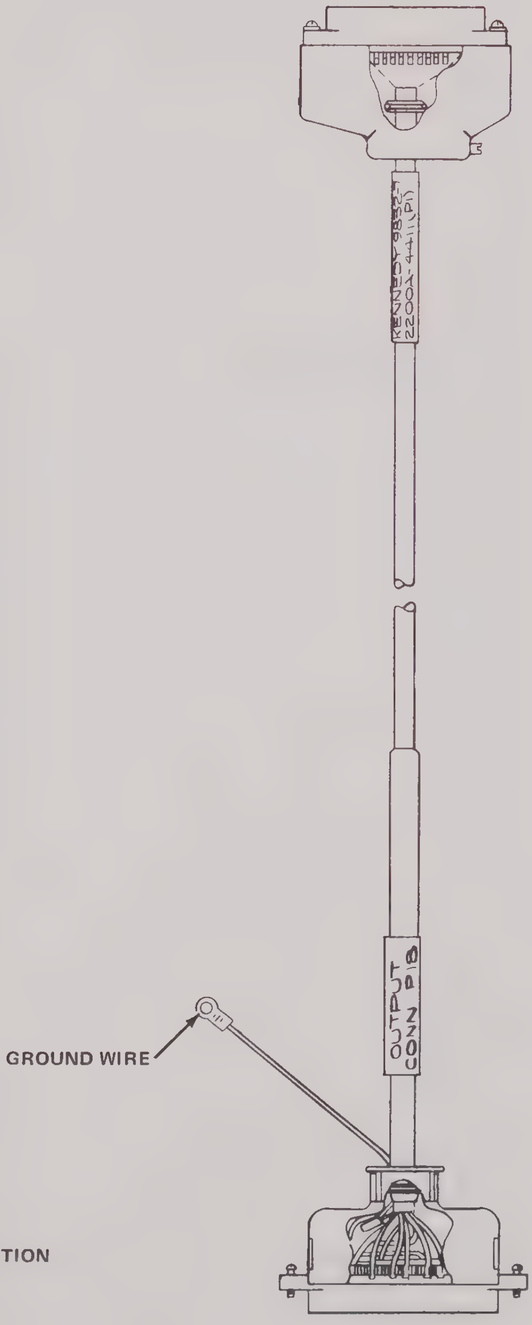

P1
MAG TAPE CONN P1
OUTPUT CONN. P18
GROUND WIRE
P18

3▷ Common ground wire connections.

2200A–4404

Figure 614-6. Magnetic Tape Interface Cable Assembly

WIRE LIST	
FROM	TO
P18-1	
-2	P1-18
-3	
-4	
-5	
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	P1-17
-14	P1-14
-15	P1-12
-16	
-17	
-18	
-19	P1-4
-20	P1-6
-21	P1-7
-22	P1-5
-23	5
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	5
-32	
-33	
-34	
-35	
-36	
-37	
-38	P1-16
-39	P1-15
-40	P1-13
-41	
-42	
-43	
-44	
-45	
-46	P1-10
-47	
-48	3
-49	
P18-50	


KENNEDY 9832-1
2200A-4411 (P1)
OUTPUT CONN P18
GROUND WIRE

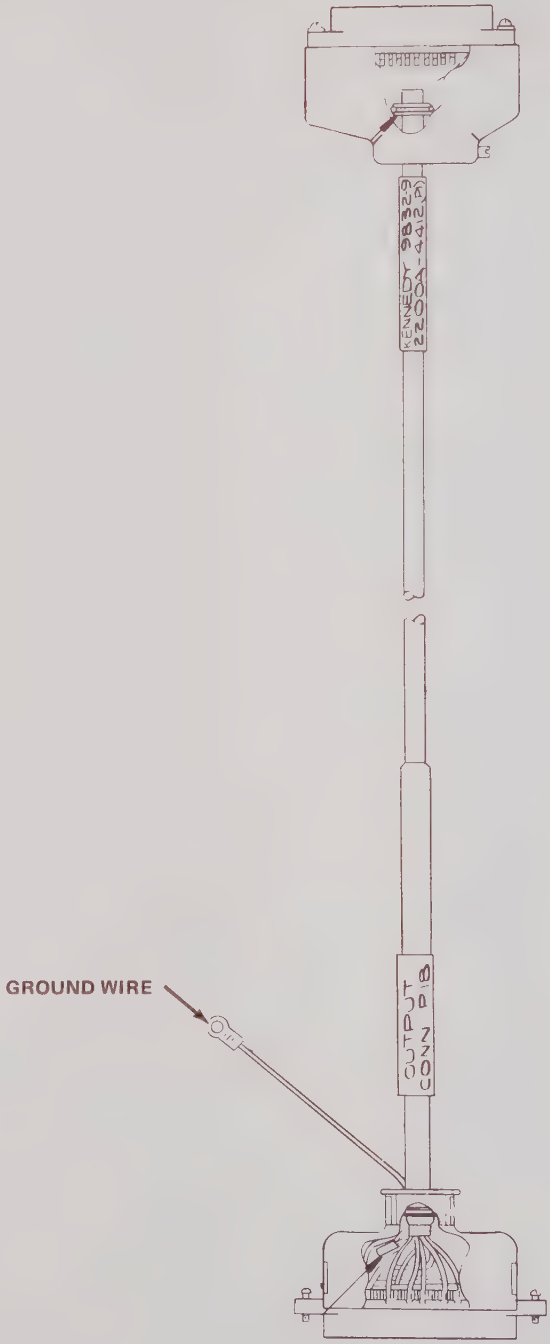
3 COMMON GROUND WIRE CONNECTION

5 P1–20 thru P1–37

2200A–4411

Figure 614-7. Magnetic Tape Interface Cable Assembly

WIRE LIST	
FROM	TO
P18-1	
-2	P 8
-3	
-4	
-5	
-6	3
-7	
-8	
-9	
-10	
-11	
-12	
-13	P 7
-14	P. 4
-15	P.- 2
-16	P
-17	
-18	
-19	P - 4
-20	P1-6
-21	P1-7
-22	P1-5
23	5
-24	
-25	
-26	
-27	
-28	
-29	
-30	
-31	3
-32	
-33	
-34	
-35	
-36	
-37	
-38	P 6
-39	P1-15
-40	P1- 3
-41	P1 10
-42	
-43	
-44	
-45	
-46	
-47	
-48	3
-49	
P18-50	


KENNEDY 9832-9
2200A-4412(P1)
GROUND WIRE
OUTPUT CONN P18

3 COMMON GROUND WIRE CONNECTION

5 P1–20 thru P1–37

2200A–4412

Figure 614-8. Magnetic Tape Interface Cable Assembly

Option —16
Digital Input

616-1. INTRODUCTION

616-2. The Digital Input Option (—16) is a plug-in pcb assembly designed to provide the printer and external recording devices with up to nine digits of externally generated digital input data. The data is derived from a remote source in bcd character-parallel format (DTL/TTL, positive-true) and loaded into storage by a remote Load Data pulse. Data cannot be loaded while the recorders are reading input data, and Busy/$\overline{\text{Busy}}$ output flags are provided to indicate the read period. Read period occurs immediately prior to the first analog data reading.

616-3. The data logger is capable of accommodating up to three Digital Input PCB's. Digital data from the pcb's is read in a sequence determined by the setting of four Address Code Switches located on each pcb. These address codes are assigned by the user so that the first pcb to be read is coded as address 0, the second is coded 1, and the third is coded 2. The physical order in which the pcb's are installed in the data logger does not influence the order in which data is read.

616-4. SPECIFICATIONS

616-5. Specifications for the Digital Input Option (—16) are given in Table 616-1.

Table 616-1. Digital Input Option Specifications

Number of Digits	Nine
Input Code	BCD, positive-true
Logic Levels	DTL/TTL
Control Inputs	Load Data, Busy, Busy
Record Location	Follows Fixed Data

616-6. INSTALLATION

616-7. Up to three Digital Input PCB's can be mounted in the data logger's I/O slots, as shown in Figure 616-1. Install each pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

a. Set the data logger's POWER switch to OFF.

b. Remove the top cover from the data logger.

c. Locate the Address Code Switches on each Data Input PCB as shown in Figure 616-1, and assign consecutive address codes (starting with 0) to each pcb by setting the switches to the patterns shown in Table 616-2. When Digital Input Data is recorded address 0 is read first, 1 second, and 2 last.

d. Align each Data Input PCB in its selected I/O slot so that the large female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down onto the mating connector.

e. After the Digital Input PCB(s) is (are) installed, install the top cover.

ADDRESS CODE	ADDRESS CODE SWITCH SETTINGS			
	1	2	3	4
0	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON

616-8. OPERATION

616-9. Once installed in the data logger, the Digital Input Option requires no operator attention. However, certain considerations are necessary to properly

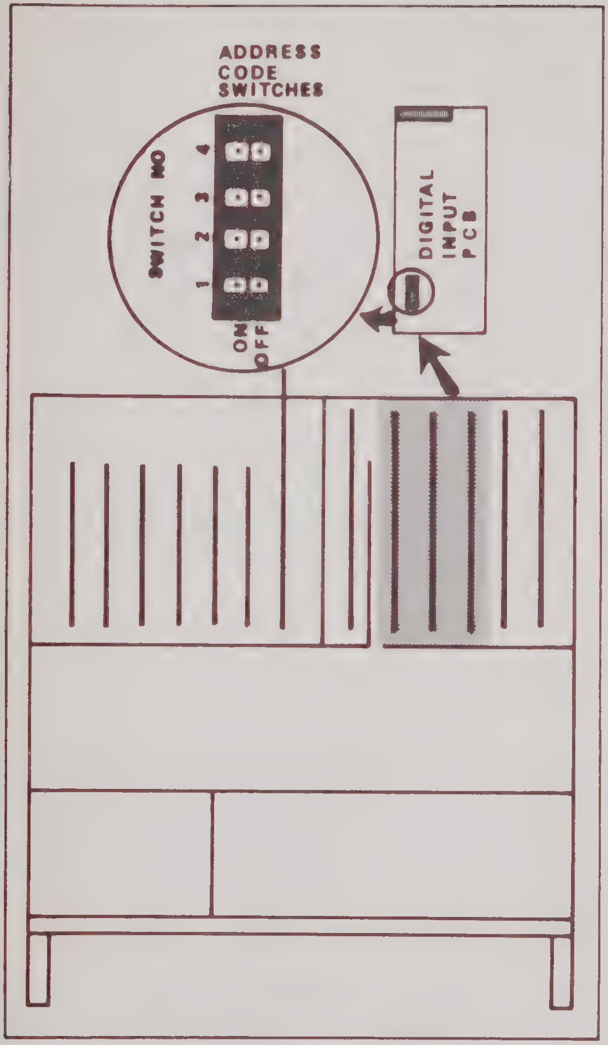


Figure 616-1. Data Input Option, Installation and Switch Locations

interface the option with remote input data. These considerations are covered in the following paragraphs.

616-10. Interface Connections

616-11. Remote interface connections to a Digital Input PCB are completed through a General Purpose Interface Cable (2200A-7006) or a blank Interface Connector (2200A-7007) which attaches to the digital input connector at the rear of the data logger. The cable assembly is supplied as part of the Digital Input Option and the connector is available as an accessory. A description of the Connector is given earlier in this section under accessories.

616-12. The user is responsible for completing the cable connections to the remote data source. The pin assignments for the Digital Input Option rear-panel connector are given in Table 616-3.

Table 616-3. Option —16, I/O Connector (J33) Pin Assignments

PIN	SIGNAL		PIN	SIGNAL	
1	N/C		26	$\overline{\text{LOAD}}$	
2	DB0	DIGIT 4	27	DB3	DIGIT9 (MSD)
3	DB1		28	DB2	
4	DB2		29	DB1	
5	DB3		30	DB0	
6	$\overline{\text{BUSY}}$		31	SIGNAL GND.	
7	BUSY		32	SIGNAL GND.	
8	DB3	DIGIT 3	33	DB0	DIGIT8
9	DB2		34	DB1	
10	DB1		35	DB2	
11	DB0		36	DB3	
12	N/C		37	+5V dc	OUTPUT
13	N/C		38	+5V dc	
14	DB3	DIGIT 2	39	DB0	DIGIT7
15	DB2		40	DB1	
16	DB1		41	DB2	
17	DB0		42	DB3	
18	N/C		43	DB0	DIGIT6
19	N/C		44	DB1	
20	DB3	DIGIT 1 (LSD)	45	DB2	
21	DB2		46	DB3	
22	DB1		47	DB3	DIGIT5
23	DB0		48	DB2	
24	N/C		49	DB1	
25	N/C		50	DB0	

N/C = No Connection

616-13. I/O Data Requirements

616-14. The I/O requirements necessary to load data into a Digital Input Option PCB are given in Table 616-4. See Table 616-3 for I/O connector pin assignments.

616-14. Ground Loop Considerations

616-15. Data inputs to the Digital Input PCB are not isolated and, therefore, are referenced to the data loggers unguarded +5V dc supply (logic common). To protect both the data logger and the external data source from damage due to ground loops, a fuse is installed on the Digital Input PCB. Fuse replacement details are given later under maintenance.

616-16. THEORY OF OPERATION

616-17. The Digital Input PCB as shown in Figure 616-2 functions as a remote data interface to provide the Controller with up to nine externally-generated digits of input data. Ultimately the Controller presents this data to the printer as supplemental heading information. The input digits are derived from a user supplied data source and are received at the Digital Input PCB in character-parallel format. An externally generated load pulse enters the parallel digits into a series of storage registers on the pcb. This stored data is then solicited via Control Bus A and read into the Controller via the Data Bus. While the Controller is reading data from the registers, a complementary pair of Busy flags is generated by the Digital Input PCB. These flags indicate the duration of the read period and are intended for use in providing the external data source with legal load-period timing. This is necessary since the storage registers cannot be updated while they are being read by the Controller. All data and control inputs/outputs to the external data source are positive-true DTL/TTL logic levels.

Table 616-4. I/O Data Requirements

Logic Levels	DTL/TTL compatible, positive true.
Input Data Format .	Up to nine BCD, character-parallel digits.
Load Pulse	Input Data is loaded by a negative going pulse at the Load input. The pulse duration must be ⩾50 µs.
Busy/$\overline{\text{Busy}}$	Input data can be loaded any time the $\overline{\text{Busy}}$ pulse is low or the Busy pulse is high.
Unused Digits	The inputs for unused digits may be left open. Data will not be recorded in these positions.
+5V dc Output	A +5V dc output is available to power external circuitry. The total current drain should not exceed 50 mA.

616-18. Operation can be logically divided into two sequences; load and read. Load sequences are initiated by an externally generated Load command and can be executed any time a read sequence is not in progress. Complementary Busy flags are provided to indicate the legal load periods. Read sequences are initiated under the direction of the Controller and include an address verification routine to ensure that the proper output pcb has been addressed. This is necessary since up to three Digital Input PCB's can be installed in a data logger.

616-19. A load sequence is initiated when a low level (⩾50 µs) is applied to the Load input of the Digital Input PCB. If a read sequence is not in progress, the next Sync pulse from the Controller sets a pair of flip-flops in the control logic. This generates the leading edge of the data load pulse causing all nine digits of external input data to be loaded into a series of parallel input digit latches. On the next Sync pulse the data load pulse is terminated. When the external Load input returns high the control logic is reset, thereby arming the input register for the next load sequence.

616-20. A read sequence is initiated when the Controller places a binary coded 7 onto the Control Bus A and the Digital Input PCB's switch address (0, 1 or 2) onto the Data Bus. When the combination of these inputs are present a compare input is presented to the control logic. On the rising edge of the subsequent Out strobe the control logic accepts the compare input to enable the read sequence. As a result the decade counter is enabled, an In strobe is enabled to serve as the counter's clock and a read (outputs) signal is generated. The combination of the read (outputs) and the count 0 outputs enable a set of four tri-state drivers which place a binary coded zero onto the data bus. The Controller recognizes this code as a valid address reply and responds by generating a series of In strobes. Each strobe advances the decade counter causing each of the nine input digit latches to be sequentially addressed. The Controller reads each new character on the leading edge of the In strobe and advances the decade counter on the strobes trailing edge. After the ninth character has been read the binary coded 7 is removed from Control Bus A. This effectively resets the control logic by clearing the enable and read outputs.

616-21. MAINTENANCE

616-22. Access Information

616-23. Refer to the installation instructions given in paragraph 616-6 for Digital Input Option access information. Remove the rear panel input connector before attempting to remove the pcb from the data logger.

616-24. Fuse Replacement

616-25. A 1/4 amp, fast-acting fuse is located on the component-side of the Digital Input PCB Assembly. If replacement is necessary, pull the old fuse from the fuse clip and press a new one into place.

616-26. Performance Test

616-27. The Digital Input Option is most easily tested under normal operating conditions. That is, installed in a functional data logger, and connected to its input data source (as provided by the user). When any scan sequence is executed and the internal printer is enabled,

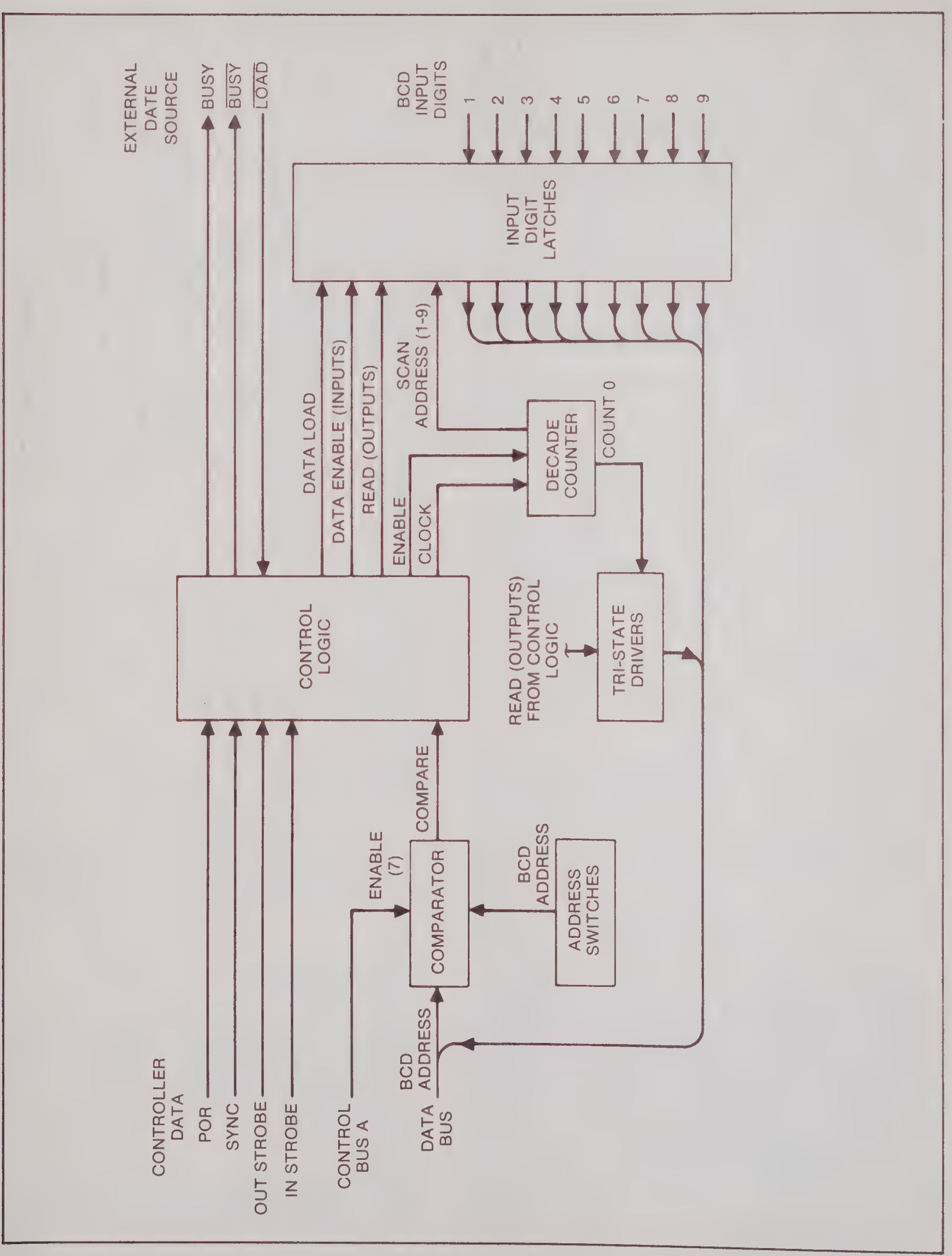

EXTERNAL DATE SOURCE
BUSY
$\overline{\text{BUSY}}$
$\overline{\text{LOAD}}$
BCD INPUT DIGITS
1
2
3
4
5
6
7
8
9
INPUT DIGIT LATCHES
DATA LOAD
DATA ENABLE (INPUTS)
READ (OUTPUTS)
SCAN ADDRESS (1-9)
ENABLE
CLOCK
DECADE COUNTER
COUNT 0
CONTROL LOGIC
READ (OUTPUTS) FROM CONTROL LOGIC
TRI-STATE DRIVERS
COMPARE
ENABLE (7)
COMPARATOR
BCD ADDRESS
ADDRESS SWITCHES
CONTROLLER DATA
POR
SYNC
OUT STROBE
IN STROBE
CONTROL BUS A
DATA BUS
BCD ADDRESS

Figure 616-2. Digital Input PCB Simplified Block Diagram

the digital input data from the data source should be printed following the fixed data entry (2240A) or the scan counter entry (2200A). If two or three Digital Input Options PCB's are installed in the same unit, input data will be printed in the order assigned by the address switch settings (see installation instructions). If no data is printed, either the fuse on the pcb is blown, input data is not being loaded correctly, or the board address has not been set correctly. If some, but not all, characters, of entered data are printed incorrectly, the input registers on the Digital Input PCB are probably defective.

616-28. LIST OF REPLACEABLE PARTS

616-29. A list of replaceable parts for the Digital Input Option is given in Table 616-5. Refer to Section 5 of this manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 616-5. Digital Input Option —16 (Continued)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	MODEL 2200A-16 DIGITAL INPUT OPTION, FINAL ASSEMBLY						
	Digital Input PCB Assembly (2200A-4017)	406397	89536	406397	1		
	General Purpose Interface Cable Assembly (2200A-4405)	373357	89536	373357	1		
	DIGITAL INPUT PCB ASSEMBLY (2200A-4017) Figure 616-3	406397	89536	406397	REF		
C1	Cap, Ta, 10 µF ±20%, 25V	330662	56289	190D106X0020-KA1	1		
F1	Fuse, fast acting, 1/4 Amp	109314	71400	AGC1-4	1	5	
J33	Connector, pcb mounting, 64-pin, female	414417	00779	552130-1	1		
R1 thru R4, R7 thru R10	Res, comp, 10k ±5%, 1/4W	148106	01121	CB1035	8		
R5, R6	Res, comp, 100 ±5%, 1/4W	147926	01121	CB1015	2		
U1	Switch Assembly	408559	00779	435166-2	1	1	
U2	IC, COS/MOS, quad exclusive-OR gate ⊗	355222	18725	CD4030AE	1	1	
U3, U4, U9, U10, U15, U16, U21, U22, U28	IC, COS/MOS, quad D-type latch ⊗	412742	12040	MM74C173N	9	2	
U5, U11, U17, U23, U29	Res, network, 100k (typical)	380618	89536	380618	5	1	
U6, U12, U18, U24, U30	Res, network, 47k (typical)	381996	89536	381996	5	1	
U7	IC, CMOS, decade counter/divider ⊗	403568	18725	CD4017AE	1	1	
U8, U14, U26, U27	IC, COS/MOS, hex buffer/converter ⊗	355214	04713	MC14009CP	4	1	
U13	IC, CMOS, triple 3-input NAND gate ⊗	375147	04713	MC14023CP	1	1	

Table 616-5. Digital Input Option —16 (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U19	IC, COS/MOS, dual J-K flip flop ⊗	355230	04713	MC14027CP	1	1	
U20, U33	IC, COS/MOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	2	1	
U25	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	1	1	
U31, U36	IC, CMOS, hex non-inverting buffer ⊗	407759	12040	MM80C97N	2	1	
U32	IC, CMOS, dual, D-type flip flop ⊗	340117	04713	MC14013CL	1	1	
U34	IC, CMOS, dual 4-input NAND gate ⊗	355206	04713	MC14012CP	1	1	
U35	IC, COS/MOS, hex buffer/converter ⊗	355412	04713	MC14010CP	1	1	
	GENERAL PURPOSE INTERFACE CABLE ASSEMBLY (2200A-4405) Figure 616-4	373357	89536	373357	REF		
P18	Connector, 64-pin, male	266056	13511	57-30500	1		
	Kit, connector hardware (hood and associated hardware)	435750	00779	552565-1	1		

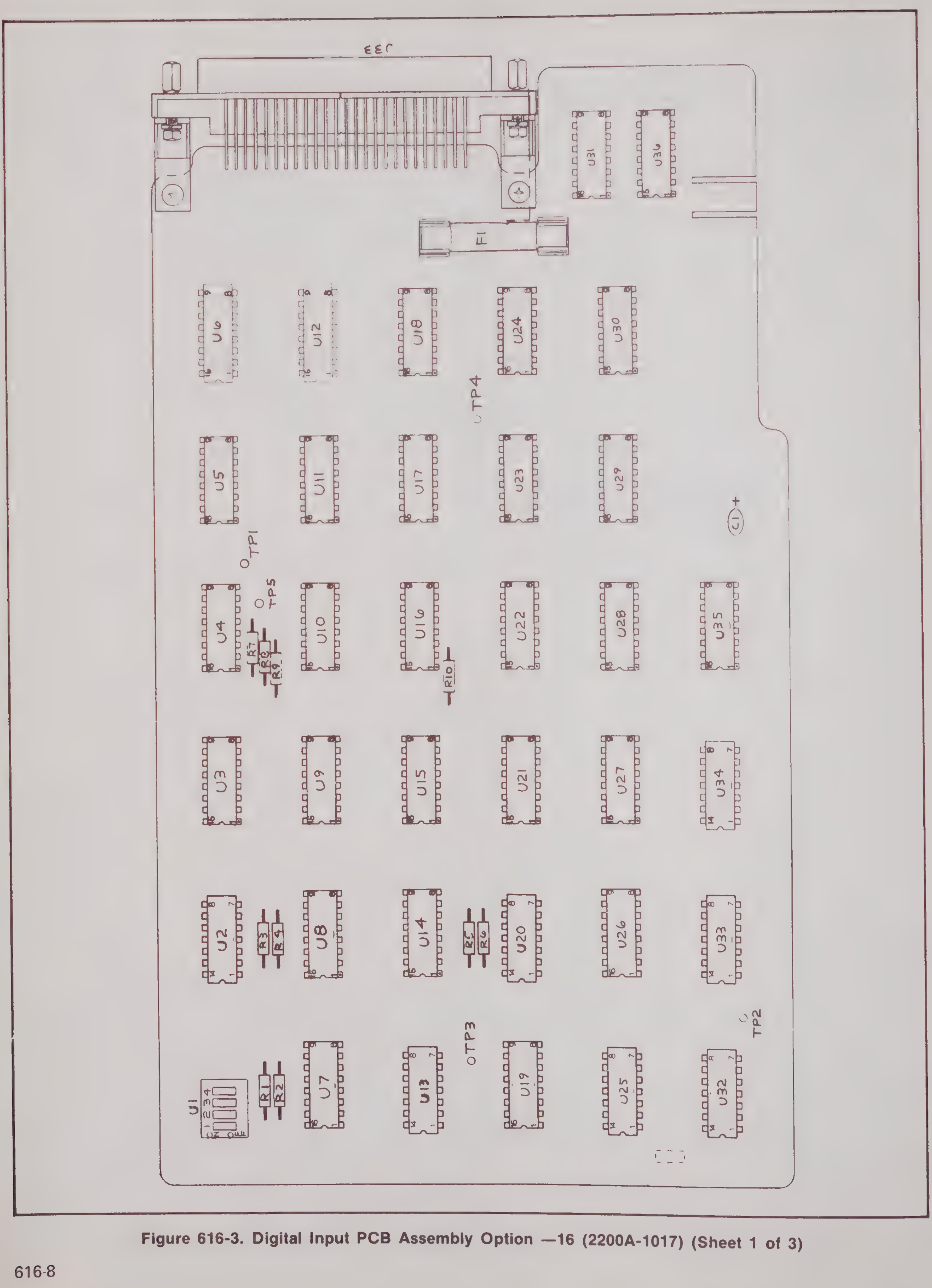
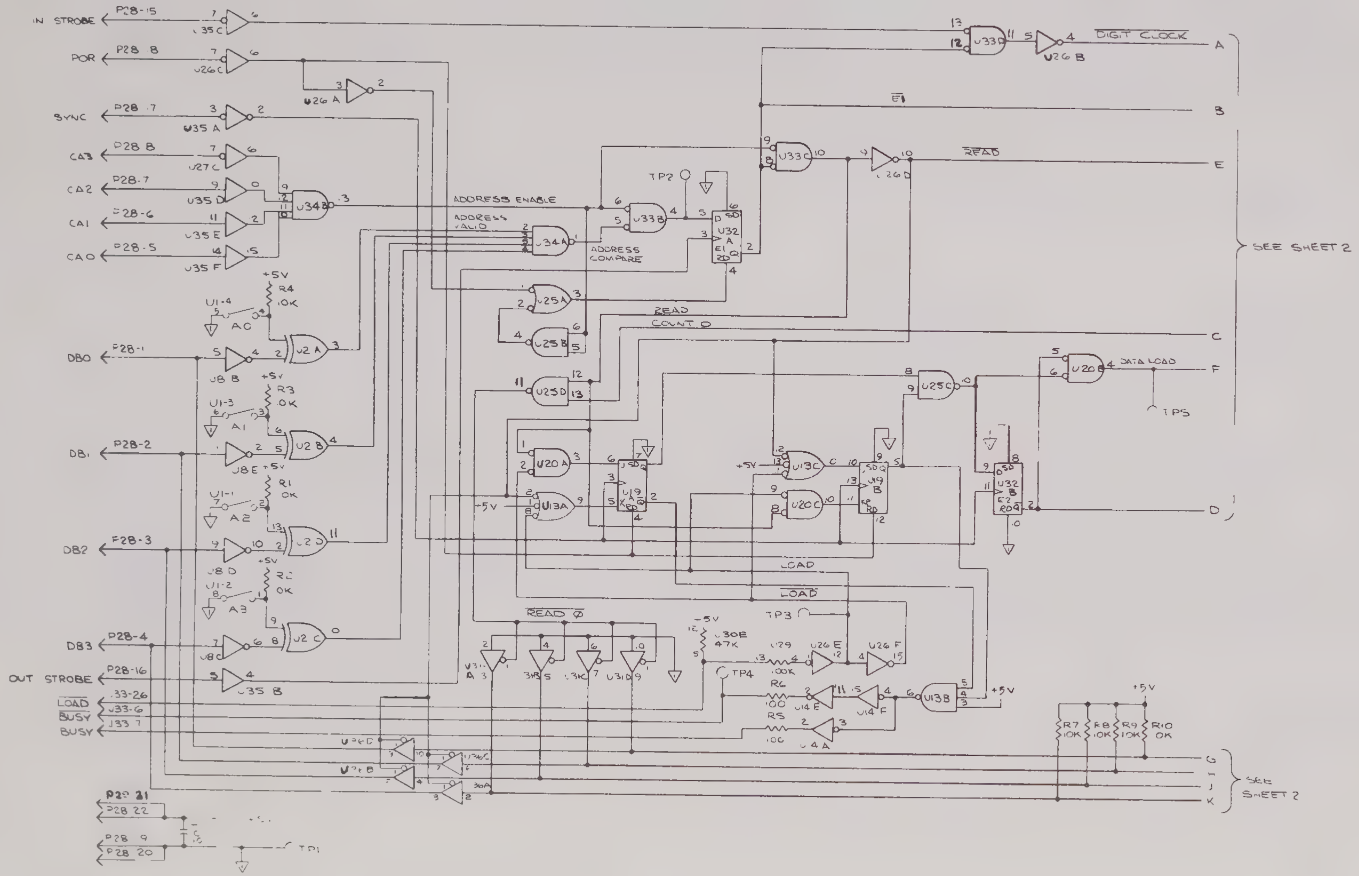

J33
F1
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21
U22
U23
U24
U25
U26
U27
U28
U29
U30
U31
U32
U33
U34
U35
U36
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
C1
TP1
TP2
TP3
TP4
TP5

Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 1 of 3)

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. FOR ASSY DWG SEE 2200A-4017.
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).


IN STROBE
P28-15
U35C
POR
P28 8
U26C
U26 A
SYNC
P28 7
U35 A
CA3
P28 8
U27C
CA2
P28-7
U35 D
CA1
P28-6
U35 E
CA0
P28-5
U35 F
U34B
ADDRESS ENABLE
ADDRESS VALID
U34A
ADDRESS COMPARE
U33B
TP2
U32 A
U33D
U26 B
DIGIT CLOCK
A
E1
B
U33C
U26D
READ
E
SEE SHEET 2
+5V
R4 10K
U1-4
A0
DB0
P28-1
U8 B
U2 A
R3 10K
U1-3
A1
DB1
P28-2
U8 E
U2 B
R1 10K
U1-1
A2
DB2
P28-3
U8 D
U2 D
R2 10K
U1-2
A3
DB3
P28-4
U8 C
U2 C
OUT STROBE
P28-16
U35 B
LOAD
J33-26
BUSY
J33-6
BUSY
J33 7
U25A
U25B
READ
COUNT 0
C
U25D
U20A
U19 A
U13A
U13C
U20C
U19 B
U25C
U20
DATA LOAD
F
TP5
U32 B
D
LOAD
LOAD
READ Ø
TP3
U30E 47K
U29 100K
U26 E
U26 F
TP4
R6 100
R5 100
U14 E
U14 F
U4 A
U13B
R7 10K
R8 10K
R9 10K
R10 0K
G
I
J
K
SEE SHEET 2
P28 21
P28 22
P28 9
P28 20
TP1

IC REF DES	PIN NC +5V	PIN NC UL COM	IC REF DES	PIN NO +5V	PIN NO UL COM
U1	—	5-8	U19	16	7,8,9
U2	4	7	U20	12,13,14	7
U3	16	8,9,15	U21	16	8,9,15
U4	16	8,4,15	U22	16	8,9,15
U5	—	—	U23	—	—
U6	9-16	—	U24	1-4,9-12	—
U7	16	8,3	U25	14	7
U8	16,1	8	U26	16	8
U9	16	8,9,15	U27	1,16	4,8
U10	16	8,9,15	U28	16	8,9,15
U11	—	—	U29	—	—
U12	1-4,9-12	—	U30	12-16	—
U13	1,3,13,14	7	U31	16	2,4,6,8,10,12,14
U14	16,1	8	U32	14	4,7,8,10
U15	16	8,9,15	U33	1,2,4	7
U16	16	8,9,15	U34	14	7
U17	—	—	U35	1,16	8
U18	1-4,9-12	—	U36	12,14-16	8

REFERENCE DESIGNATION LAST USED	REFERENCE DESIGNATION NOT USED
R10	F1
C1	
[illegible]	
S	

Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 2 of 3)

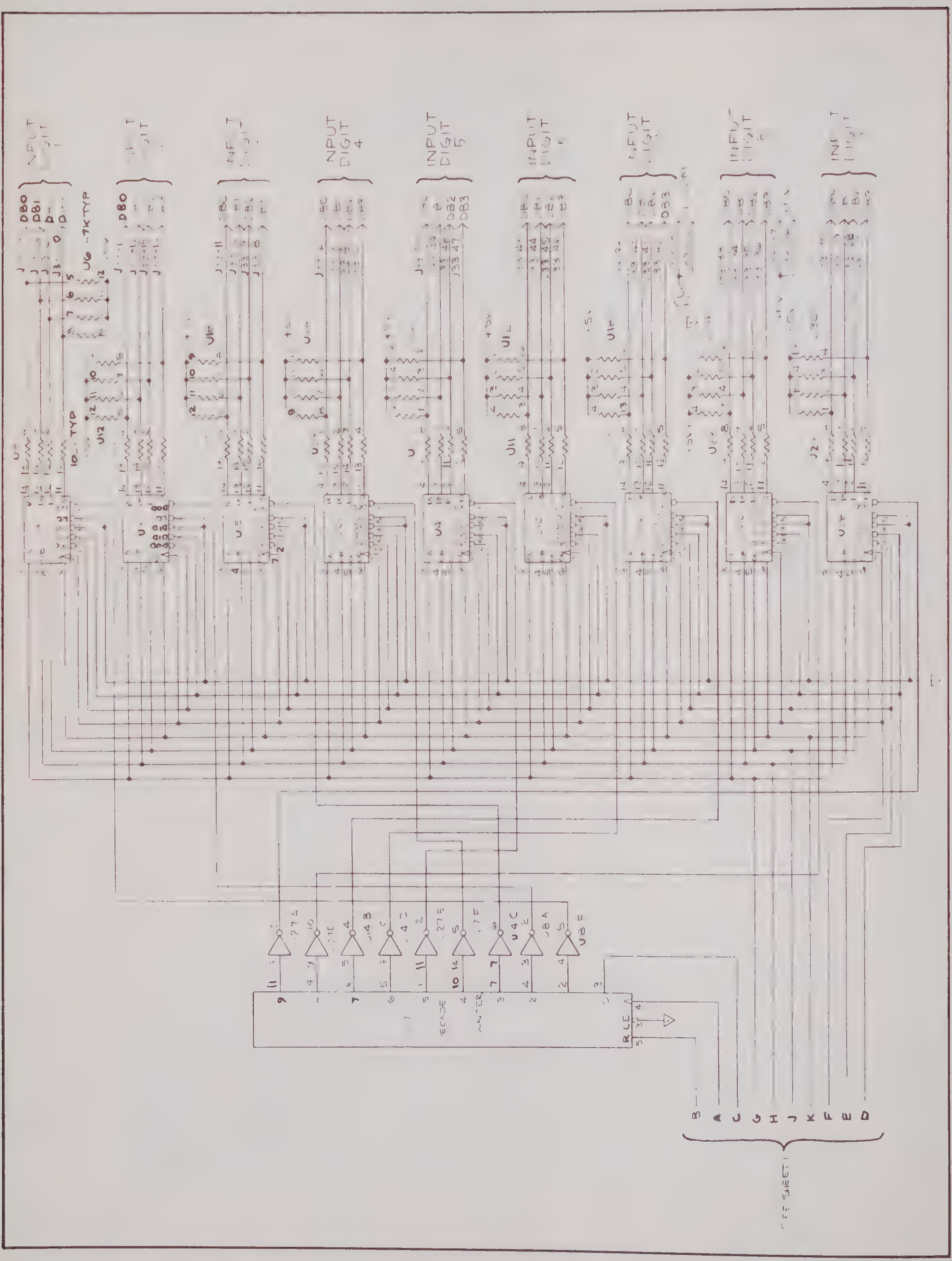

INPUT DIGIT 4
INPUT DIGIT 5
DB0
DB1
DB2
DB3
U12
U11
10 TYP
DECADE COUNTER
B
A
C
G
H
J
K
F
E
D

Figure 616-3. Digital Input PCB Assembly Option —16 (2200A-1017) (Sheet 3 of 3)

WIRE LIST

FROM	TO CABLE/COLOR
P18-1	CABLE 1 - GRY
-2	- GRN
-3	- RED
-4	- YEL
-5	- GRY/BLK
-6	- GRN/BRN
-7	- VIO
-8	- VIO/BLK
-9	- GRN/WHT
-10	- GRN/RED
-11	- YEL/WHT
-12	- GRN/BLK
-13	CABLE 1 - RED/GRY
-14	CABLE 2 - GRY
-15	- GRN
-16	- RED
-17	- YEL
-18	- GRY/BLK
-19	- GRN/BRN
-20	- VIO
-21	- VIO/BLK
-22	- GRN/WHT
-23	- GRN/RED
-24	- YEL/WHT
-25	- GRN/BLK
-26	- RED/GRY
-27	- RED/WHT
-28	- RED/GRN
-29	- VIO/WHT
-30	- GRY/WHT
-31	- VIO/RED
-32	- RED/BLK
-33	- YEL/GRY
-34	- GRY/RED
-35	- VIO/GRY
-36	- YEL/RED
-37	- GRY/GRN
-38	CABLE 2 - YEL/BLK
-39	CABLE 1 - RED/WHT
-40	- RED/GRN
-41	- VIO/WHT
-42	- GRY/WHT
-43	- VIO/RED
-44	- RED/BLK
-45	- YEL/GRY
-46	- GRY/RED
-47	- VIO/GRY
-48	- YEL/RED
-49	- GRY/GRN
P18-50	CABLE 1 - YEL/BLK

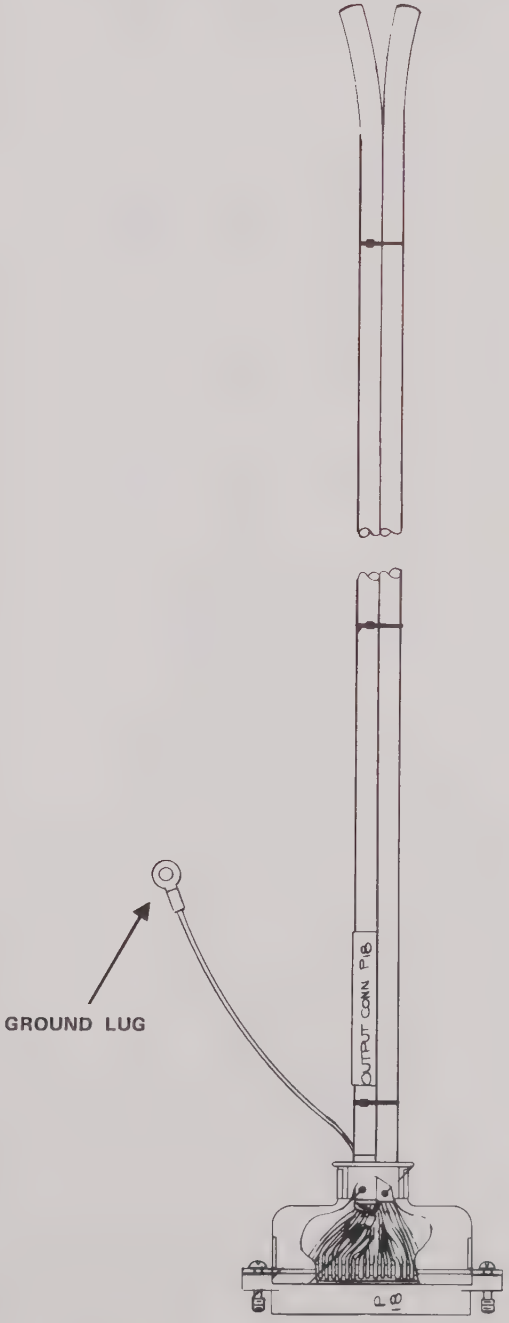


Figure 616-4. General Purpose Cable Assembly (2200A-4405)

Option —23
Alarm Set Point Output

623-1. INTRODUCTION

623-2. The Alarm Set-Point Output (Option —23) is a plug-in pcb assembly designed to provide an external output when a measurement at any channel is not within its assigned limit(s). The output is in the form of thirty separate open-collector transistors. Each collector is identified by a number (1 through 30) which corresponds to one of the limit addresses. When an output transistor is turned on, it indicates that the limit value of the corresponding limit address has been assigned to the previously measured channel, and that the measurement exceeded the limit value. Memory included on the pcb maintains all limit-exceeded indications until reset. Both manual and remote resets are provided. The manual RESET switch is located above the 2240A's Power switch. A front panel LIMIT-EXCEEDED lamp located next to the RESET switch, flashes when one or more limit values have been exceeded.

623-3. The open-collector outputs can be used separately to drive multiple external indicators, or wire OR'ed in any combination to drive one-of-two reed relays located on the Alarm Set Point Output PCB. Each reed relay provides an externally accessible, isolated contact closure when operated. Circuitry is provided on the pcb for the installation of two additional reed relays.

623-4. SPECIFICATIONS

623-5. Specifications for the Alarm Set-Point Output (Option —23) are given in Table 623-1.

623-6. INSTALLATION

623-7. The Alarm Set-Point Output PCB can be mounted in any one of the 2240A's I/O slots, as shown in Figure 623-1. Install the pcb as follows:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

a. Set the data logger's POWER switch to OFF.

b. Remove the top cover from the data logger.

c. Refer to Alarm Relays in paragraph 623-18 and ensure that the proper jumpers are installed.

d. Align the Alarm Set Point Output PCB in the selected I/O slot so that the large female connector is toward the rear of the data logger, small board-edge connector is toward

Table 623-1. Alarm Set Point Output Specifications

Compatibility	Used in conjunction with Options —21 or —22.
Number of Outputs	30 open-collector outputs (one output for each limit value).
Uncommitted Relays	2 (These relays can be hard wired to any or all of the 30 set point outputs.)
Open Collector Output Current	30 mA maximum
Relay Contact Rating	50V/1A (15 watts maximum)

the bottom of the unit. Push the pcb straight down onto the mating connector.

e. After the pcb is installed, install the top cover.

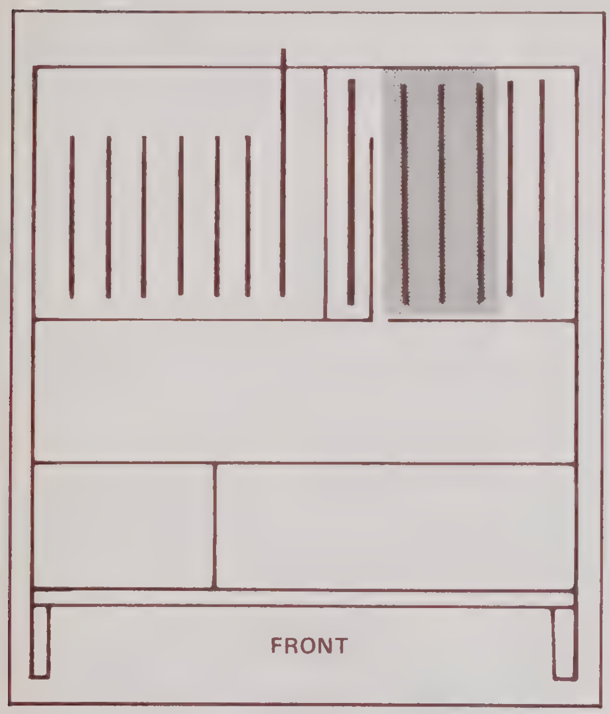


Figure 623-1. Alarm Set-Point Output, Installation Locations

623-8. OPERATION

623-9. Once installed in the 2240A, the Alarm Set-Point Output requires no operator attention. However, certain considerations are necessary to properly access and utilize the alarm outputs. These considerations are covered in the following paragraphs.

623-10. Interface Connections

623-11. Remote connections to the Alarm Set-Point Output PCB are completed through either a General Purpose Interface Cable (2200A-7006) or a blank Interface Connector, (2200A-7007). Either the cable or connector attaches to the Alarm Set-Point Output PCB connector at the rear of the data logger. Both the cable and connector are available as accessories and are described earlier in this section.

623-12. The user is responsible for completing the cable connections to the remote input device. The pin connections for the Alarm Set-Point Output's rear-panel connector are given in Table 623-2.

Table 623-2. Option —23, I/O Connector Pin Assignments

PIN	SIGNAL		PIN	SIGNAL	
1		15	26		30
2		14	27		29
3		13	28		28
4		12	29		27
5		11	30		26
6		10	31		25
7		9	32		24
8	ALARMS	8	33	ALARMS	23
9		7	34		22
10		6	35		21
11		5	36		20
12		4	37		19
13		3	38		18
14		2	39		17
15		1	40		16
16	Logic Common (Ungaurded)		41	Logic Common (Unguarded)	
17	N/C		42	N/C	
18	External Reset		43	N/C	
19	Relay 4 (Spare for Contact)		44	Relay 4 (Spare for Contact)	
20	N/C		45		
21	Relay 3 (Spare for Contact)		46	Relay 3 (Spare for Contact)	
22	N/C		47	N/C	
23	Relay 2 (Contact)		48	Relay 2 (Contact)	
24	N/C		49	N/C	
25	Relay 1 (Contact)		50	Relay 1 (Contact)	

623-13. Alarm Outputs

623-14. The alarm outputs are driven by thirty separate open-collector transistors. When a channel measurement exceeds the limit-value of its assigned limit address (0 through 30), the corresponding transistor turns-on and pulls the appropriate Alarm Output to logic common. The output is held low until it is either manually or externally reset. Each open-collector output is capable of sinking a maximum of 30 mA when turned on. The maximum VCE, when off, is +25V dc. Power dissipation is 180 mW, maximum.

CAUTION

Use an external, isolated power supply to power devices driven by the alarm outputs.

623-15. The open-collector Alarm Outputs can be used to drive TTL/CMOS logic, LED's and/or relays. The recommended interface for each of these devices is shown in Figure 623-2. Notice that an external voltage supply must be used to drive the interfaced devices. This source should provide an isolated output so that its low terminal can be referenced to the data logger's logic common (unguarded). Otherwise a ground loop will result. A fuse is provided on the Alarm Set Point Output PCB to prevent possible damage in the event of ground loop currents. Fuse replacement details are given later under maintenance.

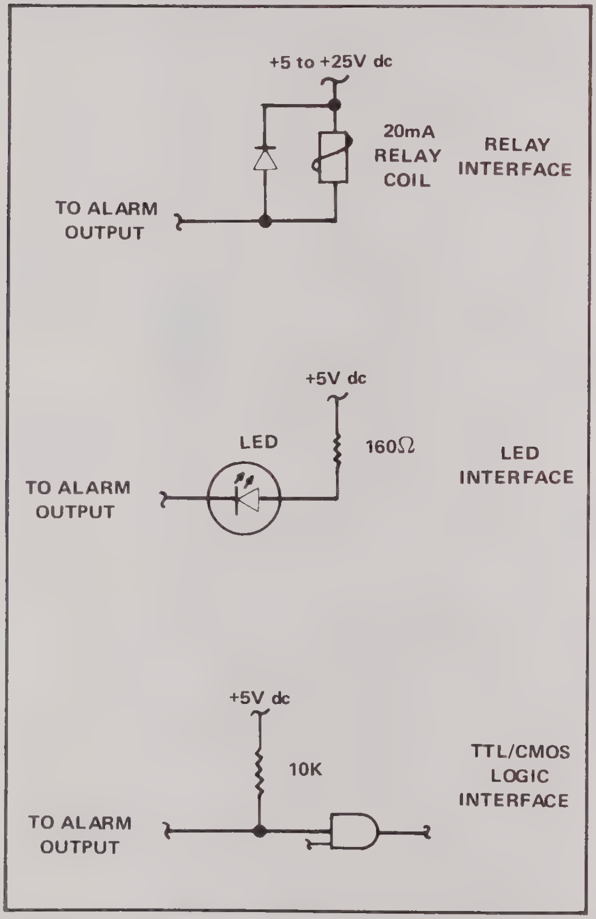


Figure 623-2. Recommended Output Alarm Interfaces

623-16. External Reset

623-17. The External Reset input responds to a low input supplied by a contact closure to logic common, or a low, TTL logic level. The reset command must be equal to or exceed 2 µs. A continuously low reset input holds all thirty alarm transistors off regardless of the inputs from the data logger. When the reset is returned high, the alarm transistors are again allowed to respond to alarm data. This function allows a simple control loop to be established using the alarm output as a command and the reset as a response to clear the command. The next scan of the 2240A will then determine if the command needs to be sent again.

623-18. Alarms Relays

623-19. Two alarm relays, K1 and K2 are provided on the Alarm Set Point Output PCB. Normally, the relays are uncommitted. However, they can be assigned by the user to operate with any combination of alarm outputs. The assignments are made by installing a series of jumpers in the spaces provided on the pcb. Figure 623-3 defines the jumper locations. The square land patterns are numbered 1 through 30 and are common to the individual open collector outputs, (1 through 30). The round land patterns are common to the K1 and K2 control buses.

623-20. When jumper wires are installed, the collectors are tied to the relay buses in a wired OR configuration. See Figure 623-4A. Therefore, when either relay is operated, all alarm outputs common to the relay bus go low. If it is desirable to maintain the integrity of the individual alarm outputs while operating the control relays, install diodes in place of the jumper wires. See Figure 623-4B.

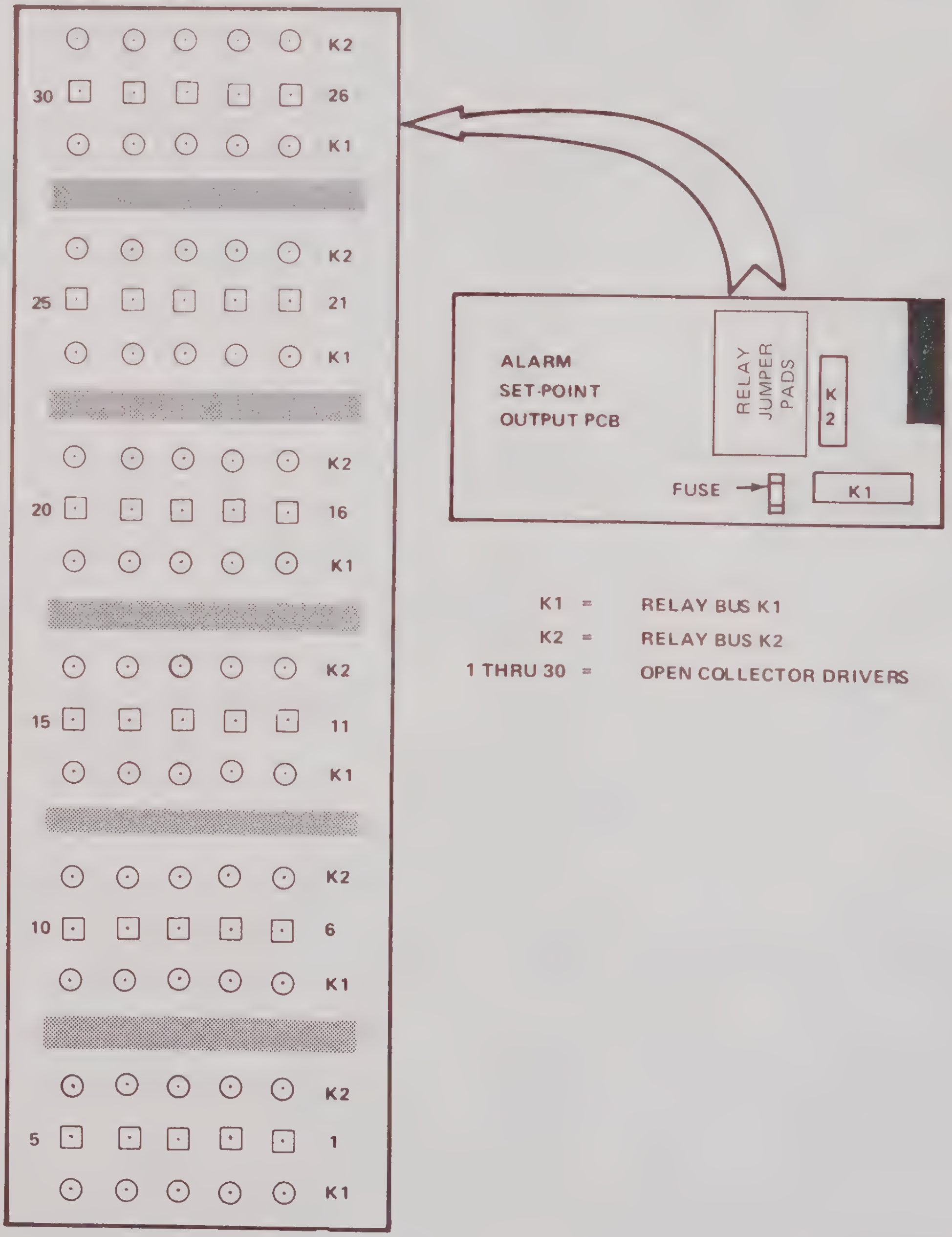
623-21. Circuitry is included on the Alarm Set-Point Output PCB for the addition of two form-A, reed relays, (K3 and K4) and their associated suppression diodes (CR3 and CR4). The I/O pin assignments for the K3 and K4 contacts are given in Table 623-2. The details necessary to install both relays are shown in Figure 623-5. The relay coils, reed switches and suppression diodes are available from the John Fluke Mfg. Co., Inc. Use the following part numbers when ordering:

a.	Relay Coil	288357
b.	Reed Switch	413294
c.	Suppression Diode	203323

623-22. THEORY OF OPERATION

623-23. The Alarm Set Point Output PCB, as shown in Figure 623-6, functions as a remote data interface to provide high/low limit information to external indicators/devices. Limit exceeded indications from the pcb are in the form of open-collector transistors and relay contacts. Thirty transistor outputs are provided; one for each of the 30 possible limit addresses. However, only two relay outputs are provided. Jumper pads on the pcb allow the user to connect the two relay coils to any combination of the output transistors.

623-24. After the data logger completes each channel measurement, it compares the measured value with the assigned limit values, if any, for that channel. If the measured value falls within the assigned limit values, no action is taken at the Alarm Set Point Output PCB. However, if an out-of-limits indication is detected, the Controller addresses the Alarm Set Point Output PCB via the Control Bus and provides it with the failed limit address. A corresponding address register on the pcb stores the limit indication and, thereby, turns-on the appropriate output transistor as a limit exceeded indication.


K2
30
26
K1
K2
25
21
K1
K2
20
16
K1
K2
15
11
K1
K2
10
6
K1
K2
5
1
K1
ALARM
SET-POINT
OUTPUT PCB
RELAY JUMPER PADS
K 2
FUSE
K1

K1 = RELAY BUS K1
K2 = RELAY BUS K2
1 THRU 30 = OPEN COLLECTOR DRIVERS

Figure 623-3. Alarm Set-Point Output PCB, Collector-to-Relay-Bus Jumper Locations

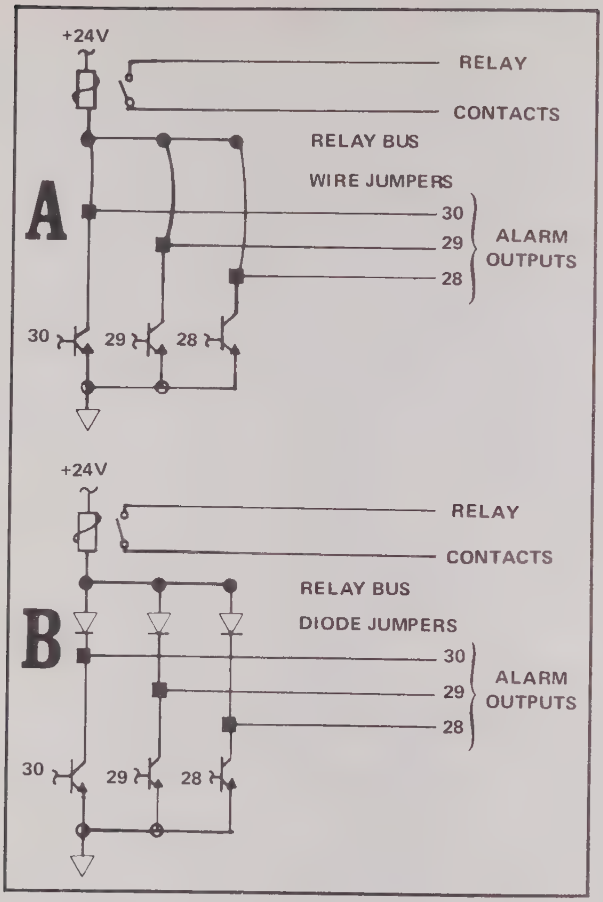
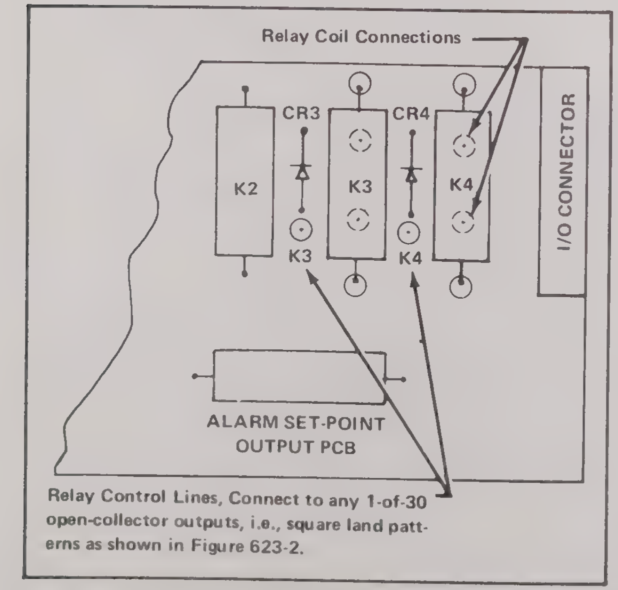


Figure 623-4. Collector-to-Relay-Bus Jumper Configurations



Relay Control Lines, Connect to any 1-of-30 open-collector outputs, i.e., square land patterns as shown in Figure 623-2.

Figure 623-5. Locations for Mounting Reed Relays K3 and K4

623-25. Limit exceeded indications are supplied to the Alarm Set Point PCB as a maximum of two successive binary coded characters (0 through 15). The first character represents limit A addresses 1 through 15 and the second represents limit B addresses 16 through 23. If the exceeded limit is from group B, the first character received on the Data Bus will be a binary zero (0000). A Strobe 1 pulse (derived from the Out strobe) is generated by the control logic causing the zero to be entered into a 4-bit latch and decoder. Prior to the next Out strobe a Sync pulse occurs causing the control logic to generate an Inhibit 1 pulse. This pulse allows the decoder to read the 4-bit latch and enable the appropriate output (1-of-16); in this case 0 (zero). Normally, a decoder output of 1 through 15 would set 1 of the 15 R-S latches assigned to limit A. However, since the output is 0 (zero), all of the latches remain in their reset state.

623-26. The second address character (limit B) is placed onto the Data Bus when the next Out strobe occurs. As before a strobe pulse (Strobe 2) is generated by the control logic and the limit address is entered into a 4-bit latch and decoder. On the following Sync pulse the resulting Inhibit 2 pulse enables the decoded output (representing addresses 16 through 30) allowing it to set the corresponding R-S latch. The set-latch turns-on the appropriate transistor driver and generates a low limit B alarm output.

623-27. When the limit exceeded indication is in the limit A group the Controller supplies only one character (limit A address) rather than two, as previously described for a limit B address. This is necessary since a zero entered into the limit B latch and decoder represents a reset for all 30 R-S latches. Reset occurs when the front panel LIMIT EXCEEDED RESET switch is pressed or when an external reset is entered at the Alarm Set Point Output PCB.

623-28. MAINTENANCE

623-29. Access Information

623-30. Refer to the installation instructions given in paragraph 623-6 for Alarm Set-Point Output PCB access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

623-31. Fuse Replacement

623-32. A 1/2 amp, fast acting fuse is located on the component-side of the Alarm Set-Point Output PCB Assembly. If replacement is necessary, pull the old fuse from the fuse-clip and press a new one into place.

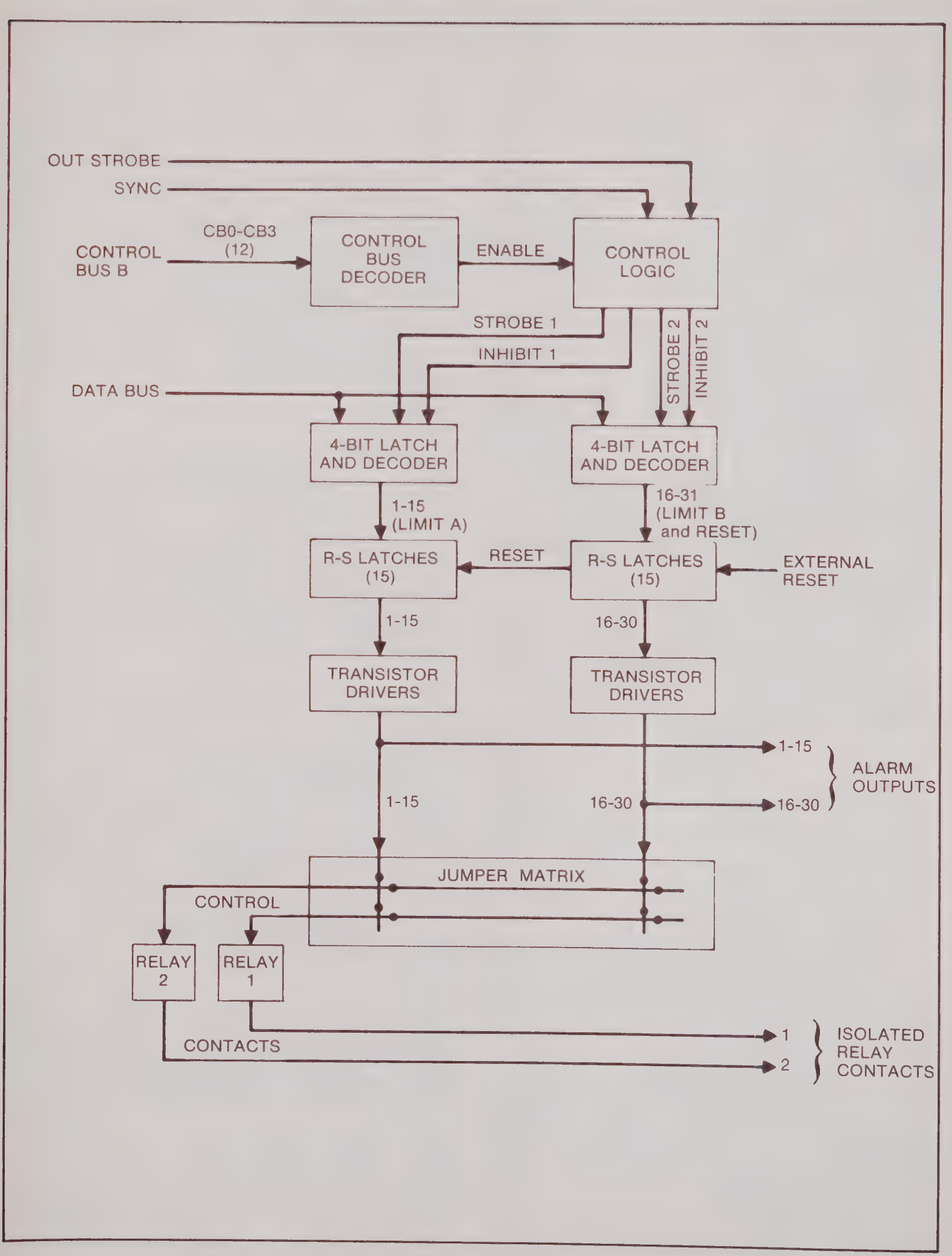

OUT STROBE
SYNC
CB0-CB3
(12)
CONTROL
BUS B
CONTROL
BUS
DECODER
ENABLE
CONTROL
LOGIC
STROBE 1
INHIBIT 1
STROBE 2
INHIBIT 2
DATA BUS
4-BIT LATCH
AND DECODER
4-BIT LATCH
AND DECODER
1-15
(LIMIT A)
16-31
(LIMIT B
and RESET)
R-S LATCHES
(15)
RESET
R-S LATCHES
(15)
EXTERNAL
RESET
1-15
16-30
TRANSISTOR
DRIVERS
TRANSISTOR
DRIVERS
1-15
ALARM
OUTPUTS
1-15
16-30
16-30
JUMPER MATRIX
CONTROL
RELAY
2
RELAY
1
CONTACTS
1
2
ISOLATED
RELAY
CONTACTS

Figure 623-6. Alarm Set Point Output PCB, Simplified Block Diagram

623-33. Performance Test

623-34. The Alarm Set Point Output PCB Assembly is most easily tested under normal operating conditions. That is, installed in a functional data logger and connected to the output devices it normally drives. Each alarm output can then be checked for pass or fail indications by limit-address and limit-value programming. Use the MONITOR scan control mode to ensure constant observation of the channel to which the limit address in question is assigned. Also be sure to reset the Alarm Ouput PCB when a limit is exceeded (see Internal Reset earlier in this subsection).

623-35. LIST OF REPLACEABLE PARTS

623-36. A lsit of replaceable parts for the Digital Input Option is given in Table 623-3. Refer to Section 5 of this manual for ordering information.

CAUTION

Indicated devices are subject to damage by static discharge.

Table 623-3. Alarm Set Point Output, Option —23

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	ALARM SET POINT OUTPUT PCB ASSEMBLY, OPTION —23 **Figure 623-7**						
C1	Cap, Ta, 10 μF ±20%, 10V	176214	56289	196D106X0010-KA1	1		
CR1, CR2, CR5	Diode, hi-speed switching	203323	07910	1N4448	3	1	
F1	Fuse, fast acting, 1/2 Amp	153858	71400	AGC1-2	1	5	
J37	Connector, pcb mounting	414417	00779	552130-1	1		
K1, K2	Coil, reed relay	288357	71707	SP-6-P	2		
K1, K2	Switch, reed	413294	89536	413294	2		
Q1 thru Q30	Xstr, Si, NPN	330803	07263	MPS6560	30	6	
TP1, TP2	Connector, post	267500	00779	87022-1	2		
	Connector, hardware kit	435750	00779	552565-1	1		
U1 thru U6, U8 thru U11, U13 thru U17	IC, CMOS, dual D-type flip flop ⊗	340117	04713	MC14013CL	15	3	
U7, U12	IC, CMOS, 4-bit latch/4-to-16 line decoder ⊗	414342	18725	C04514BE	2	1	
U18, U21	IC, CMOS, quad 2-input NOR gate ⊗	355172	04713	MC14001CP	2	1	
U19	IC, CMOS, dual J-K flip flop ⊗	355230	04713	MC14027CP	1	1	
U20	IC, CMOS, quad 2-input NAND gate ⊗	355198	04713	MC14011CP	1	1	
U22	IC, CMOS, hex buffer/converter ⊗	355412	04713	MC14010CP	1	1	

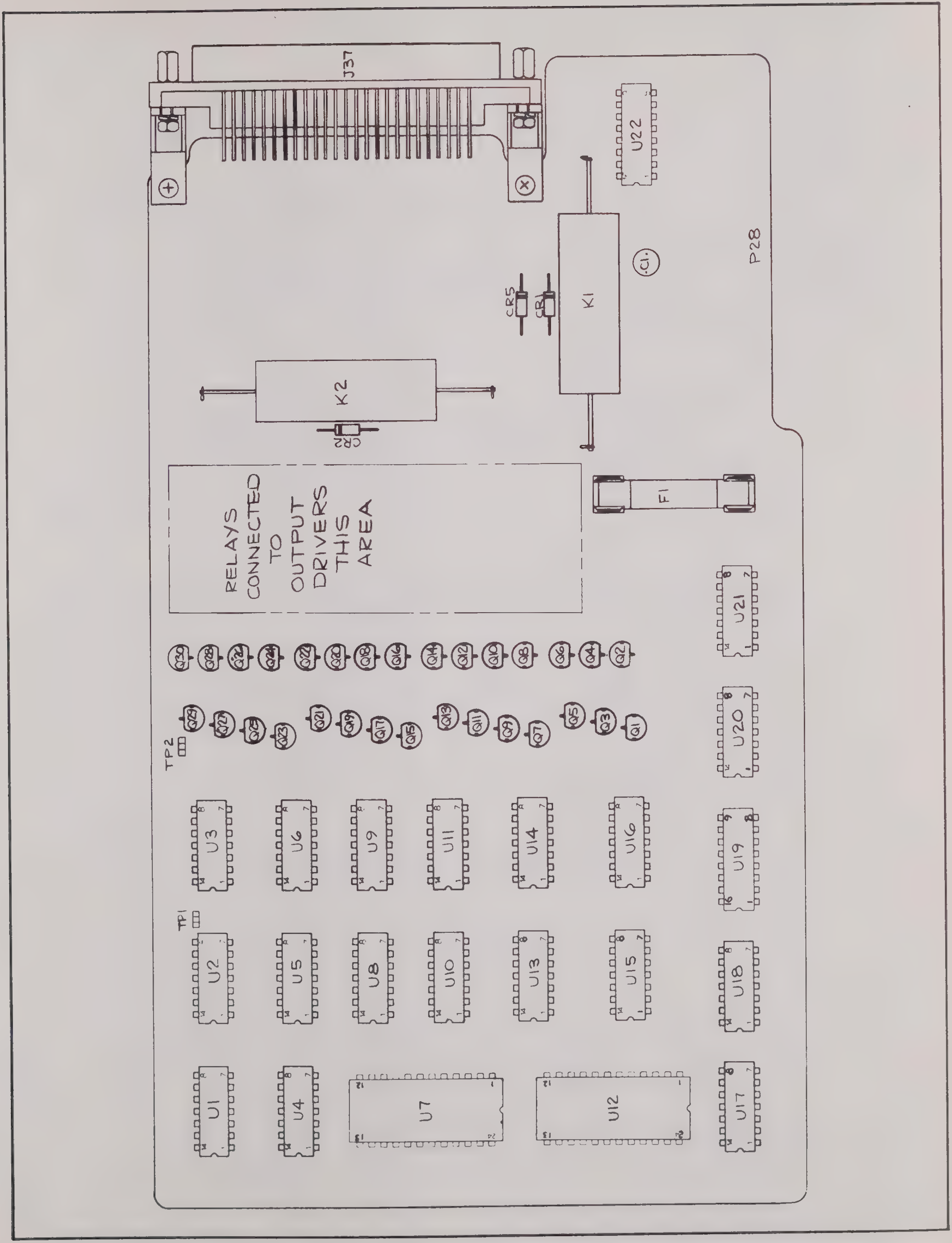

J37
U22
P28
C1
K1
CR5
CR1
K2
CR2
F1
RELAYS CONNECTED TO OUTPUT DRIVERS THIS AREA
Q30
Q28
Q26
Q24
Q22
Q20
Q18
Q16
Q14
Q12
Q10
Q8
Q6
Q4
Q2
Q29
Q27
Q25
Q23
Q21
Q19
Q17
Q15
Q13
Q11
Q9
Q7
Q5
Q3
Q1
TP2
TP1
U3
U6
U9
U11
U14
U16
U2
U5
U8
U10
U13
U15
U1
U4
U7
U12
U21
U20
U19
U18
U17

Figure 623-7. Alarm Set Point Output PCB Assembly, Option —23 (2240A-1031) (Sheet 1 of 2)

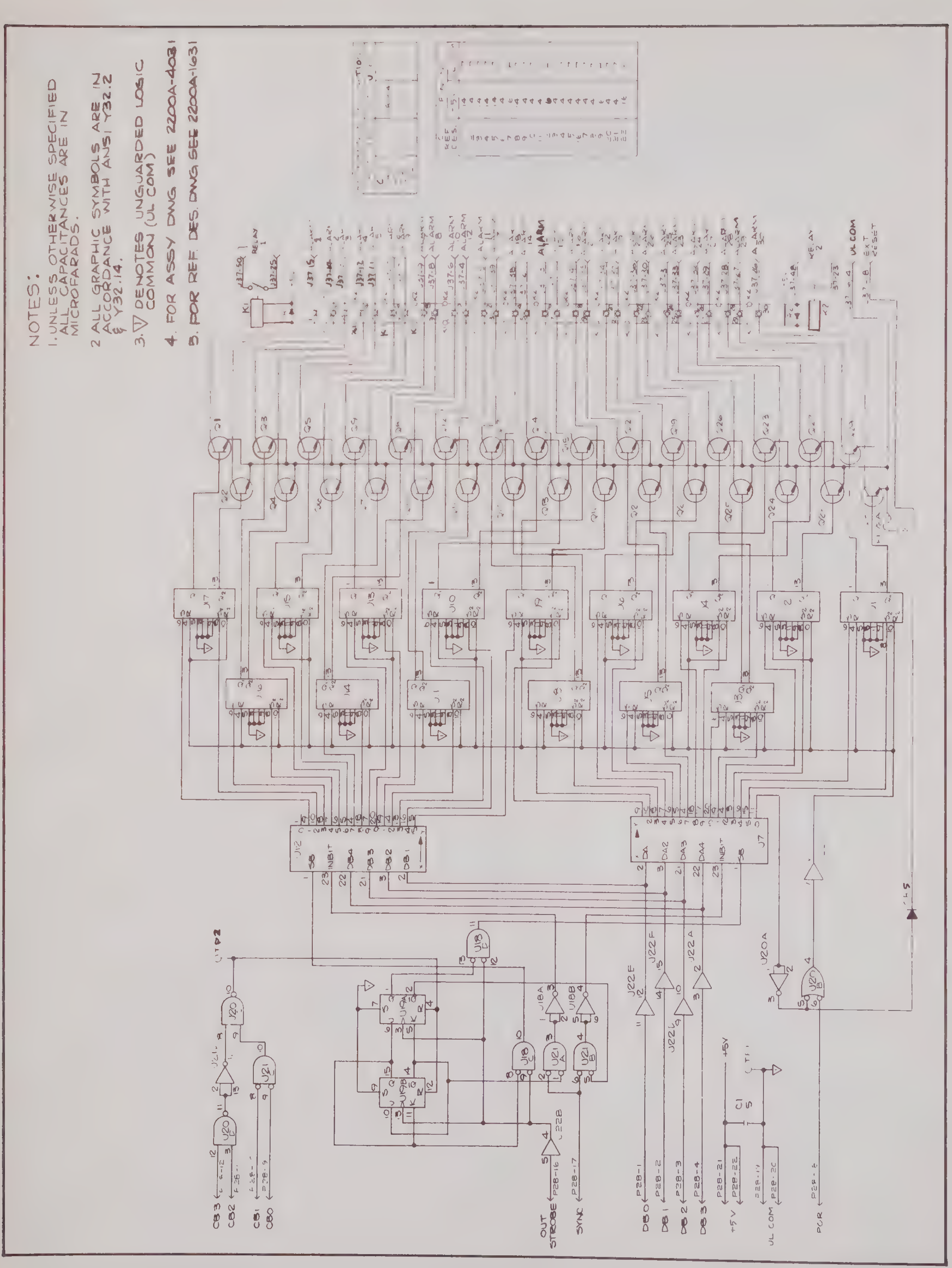
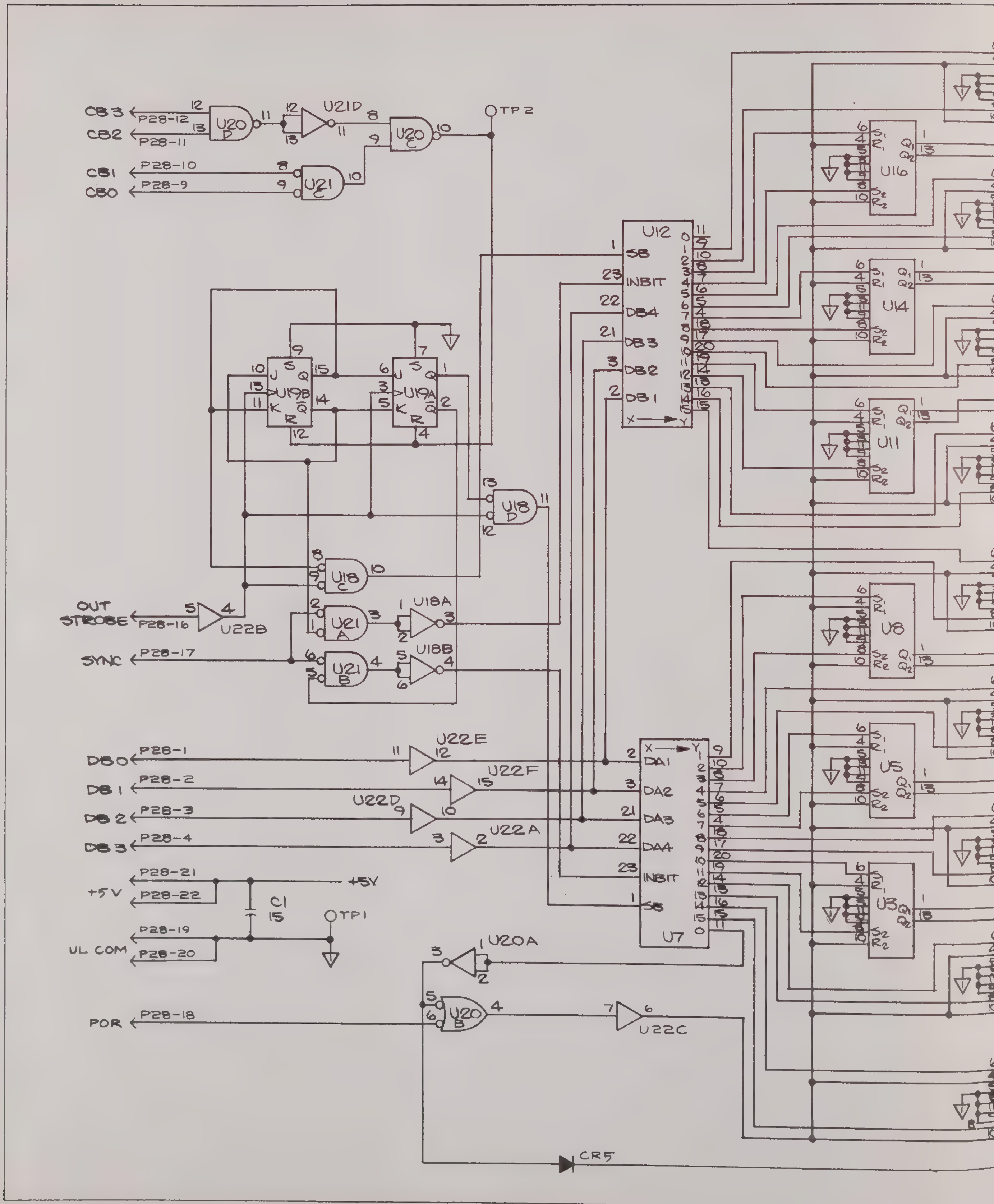
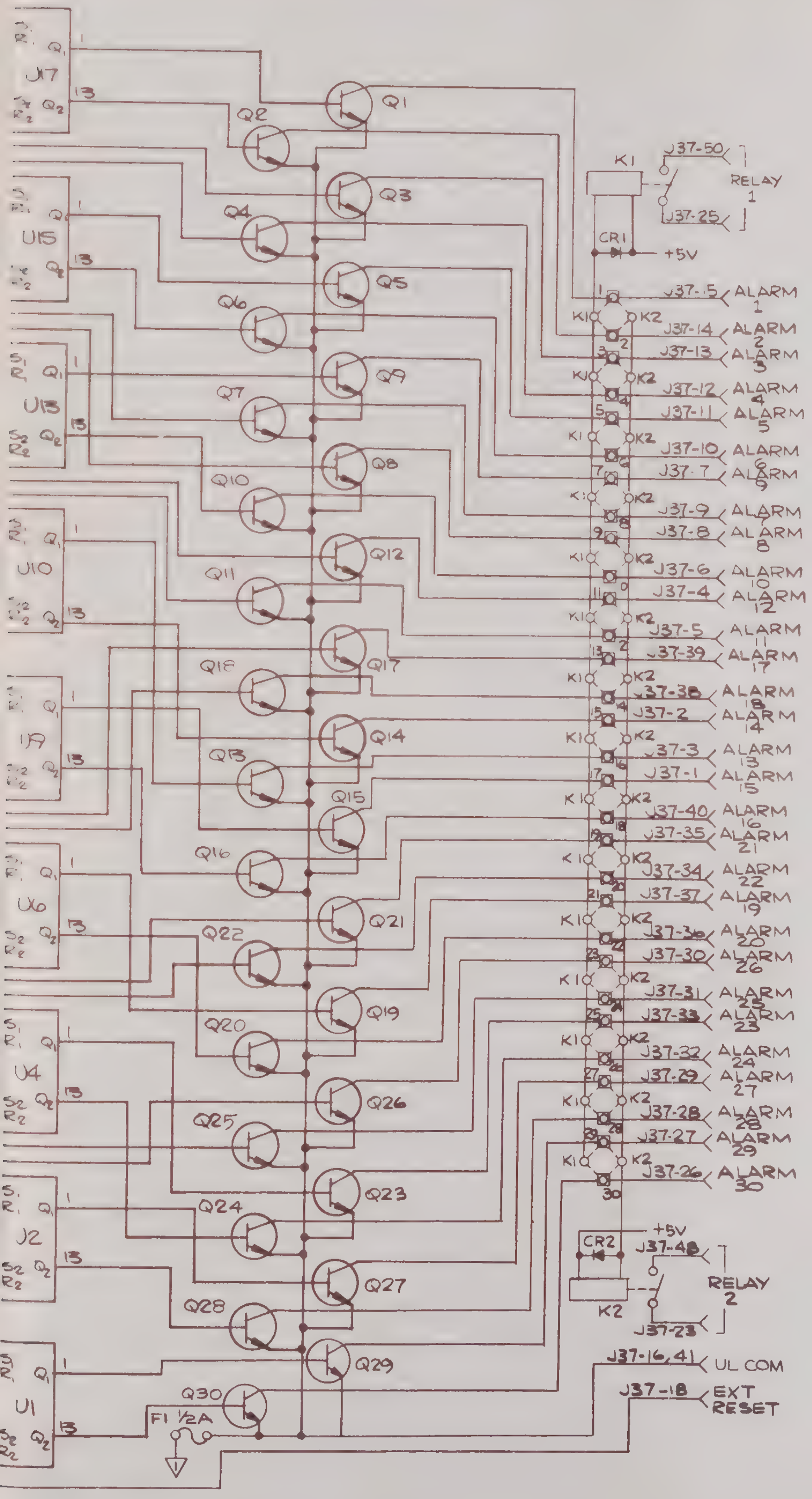

NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCES ARE IN MICROFARADS.
2 ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 & Y32.14.
3. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM)
4. FOR ASSY DWG SEE 2200A-4031
5. FOR REF. DES. DWG SEE 2200A-1631
REF DES.
K1
RELAY 1
ALARM
RELAY 2
UL COM
EXT RESET
J12
INBIT
DB4
DB3
DB2
DB1
J7
DA1
DA2
DA3
DA4
J18
U19A
U19B
J20
J21
J22A
J22B
J22C
J22D
J22E
J22F
J20A
J20B
+5V
C1
5
CB3
CB2
CB1
CB0
OUT STROBE
SYNC
DB0
DB 1
DB 2
DB 3
+5V
UL COM
PCR
P28-1
P28-2
P28-3
P28-4
P28-16
P28-17
P28-21
P28-22
P28-9

Figure 623-7. Alarm Set Point Output PCB Assembly, Option —23 (2240A-1031) (Sheet 2 of 2)


CB3
CB2
CB1
CB0
P28-12
P28-11
P28-10
P28-9
U20 D
U21D
U20 C
U21 C
TP2
U19B
U19A
U18 D
U18 C
U18A
U18B
U21 A
U21 B
OUT STROBE
P28-16
U22B
SYNC
P28-17
U12
SB
INBIT
DB4
DB3
DB2
DB1
X→Y
DB0
DB1
DB2
DB3
P28-1
P28-2
P28-3
P28-4
U22E
U22F
U22D
U22A
DA1
DA2
DA3
DA4
U7
+5V
P28-21
P28-22
C1
15
TP1
UL COM
P28-19
P28-20
U20A
U20 B
U22C
POR
P28-18
CR5
U16
U14
U11
U8
U5
U3
S1
R1
S2
R2
Q1
Q2


U17
U15
U13
U10
U9
U6
U4
U2
U1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
Q25
Q26
Q27
Q28
Q29
Q30
K1
K2
CR1
CR2
+5V
F1 1/2A
J37-50
J37-25
RELAY 1
J37-5 ALARM 1
J37-14 ALARM 2
J37-13 ALARM 3
J37-12 ALARM 4
J37-11 ALARM 5
J37-10 ALARM 6
J37-7 ALARM 9
J37-9 ALARM 7
J37-8 ALARM 8
J37-6 ALARM 10
J37-4 ALARM 12
J37-5 ALARM 11
J37-39 ALARM 17
J37-38 ALARM 18
J37-2 ALARM 14
J37-3 ALARM 13
J37-1 ALARM 15
J37-40 ALARM 16
J37-35 ALARM 21
J37-34 ALARM 22
J37-37 ALARM 19
J37-36 ALARM 20
J37-30 ALARM 26
J37-31 ALARM 25
J37-33 ALARM 23
J37-32 ALARM 24
J37-29 ALARM 27
J37-28 ALARM 28
J37-27 ALARM 29
J37-26 ALARM 30
J37-48
J37-23
RELAY 2
J37-16, 41 UL COM
J37-18 EXT RESET

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCES ARE IN MICROFARADS.
2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 & Y32.14.
3. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM)

I.C. REF. DES.	PIN NO.	
	+5V	UL COM
U1	14	7
U2	14	7
U3	14	7
U4	14	7
U5	14	7
U6	14	7
U7	16	8
U8	14	7
U9	14	7
U10	14	7
U11	14	7
U12	16	8
U13	14	7
U14	14	7
U15	14	7
U16	14	7
U17	14	7
U18	14	7
U19	16	8
U20	14	7
U21	14	7
U22	1,16	8

2240A-1031

Figure 623-7. Alarm Set Point Output PCB Assembly (cont)

Option —26
Multiple Scaling

626-1. INTRODUCTION

626-2. The basic Model 2240B Data Logger measures, records and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals produced by external transducers, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, etc. If proper signal conditioning and the appropriate scaling option are used, the data logger will measure, scale and record data directly in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μV to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires adding one or more of the available scaling options to the 2240B Data Logger as shown in Table 626-1. The —11, —25 and —27 options are described in detail in separate pages of the options section in this manual.

626-3. The —11 Temperature and Current Transmitter Option consists of an analog temperature pcb which attaches to the A/D Converter; a linearization ROM which contains the linearization program for the microprocessor; linearization tables for the J, K, R, S, T, E, B, C, G, and D (W3) thermocouple types; and a configuration PROM, which relates front panel programming via data entry keys T1, T2, T3, and T4 to the proper linearization table, A/D converter range, and engineering units. (An optional PROM may be used when other thermocouples, RTD's, or current transmitters are used.) The PROM or ROM plugs into the Controller PCB. Refer to Section 6 of the data logger manual for detailed information including specifications, operating instructions, theory of operation and maintenance, for the —11 Temperature and Current Transmitter Option.

626-4. DESCRIPTION

626-5. The —26 Multiple Scaling Option is a plug-in option that operates similar to the —11 Temperature and Current Transmitter Option. Basically, the Multiple Scaling Option allows selection of more than one custom scaling program. If one or more of the "T" functions are for thermocouples, the data logger must be equipped with the —11 Option. Depending on customer selection at time of purchase, the —26 Option provides up to four scalings per data logger in any combination.

626-6. Implementation of multiple scaling programs is accomplished by replacing the linearization ROM in the Controller with a more flexible PROM assembly. If notation of measurement units other than % for current transmitters or °C or °F for temperature is desired, the data logger must also be equipped with the —27 Engineering Units Notation Option. Refer to Section 6 of the data logger manual for detailed information concerning the —27 Option.

626-7. SPECIFICATIONS

626-8. The —26 Multiple Scaling Option consists of AX+B scaling programs selected by the customer. Points to be specified for these scalings are: input reading at low end of scale and input reading at high end of scale. Basic data logger specifications are unchanged with the inclusion of this option. Refer to Sections 1 and 6 for complete data logger and data logger option specifications.

626-9. OPERATING INSTRUCTIONS

626-10. Operating instructions for data loggers equipped with the 26 Multiple Scaling Option are the same as for the standard data logger with the addition of the customer specified T1, T2, T3, and T4 front panel functions. These functions will be designated by special markings on the front panel to indicate which linearization will be called when the corresponding function button is pressed. Refer to Section 2 for complete data logger operating instructions.

626-11. MAINTENANCE ACCESS

626-12. The Multiple Scaling PROM is located on the Controller PCB. To gain access to the PROM assembly for service or replacement, proceed as follows:

a. Turn data logger power OFF.

b. Remove the top dust cover.

c. Remove the screws securing the top right rear guard cover.

d. Remove the Controller PCB Assembly. IC U5 is the Multiple Scaling PROM. In some scaling configurations IC U11 may also be present.

CAUTION

U5 and U11 are subject to damage by static discharge.

626-13. LIST OF REPLACEABLE PARTS

626-14. IC's U11 and/or U5 are programmed and labeled in accordance with customer specifications. When replacement is necessary special markings from the original part must accompany the order for these parts.

Table 626-1. Data Logger Measurement and Scaling Options

OPTION	COMPATIBLE TRANSDUCERS			READOUT	FACTORY INSTALLED OPTION ONLY	REMARKS
	Thermocouples	RTD's	Current Transmitters			
2240B-11 Temperature and Current Transmitter Option	J, K, T, R, S, E, B, C, G, D (W3, J-DIN, K-DIN, S-DIN, T-DIN	385 Platinum 392 Platinum	1-5 mA, 4-20 mA, 10-50 mA Scaled 0 to 100%	Thermocouples and RTD's in °C or °F, Current Transmitters in %	Yes	Provides up to four transducer inputs (T1 thru T4) selected in any combination. °C or °F selected by a switch on the Controller PCB. Readout in units other than % for Current Transmitters or °C/°F for temperature requires addition of Option –27.
2240B-25 Temperature and Single Scaling Option	Any three J, K, T, R, or S thermocouple, plus one custom transducer with an output in the range of 1 μV to 40V dc or current (when using Options –28, –29, or –30).			As specified by customer	Yes	Provides one custom linear scaling for transducer input specified by the customer.
2240B-26 Multiple Scaling Option	Up to four custom scalings, AX+B type			As specified by customer.	Yes	Provides up to four scalings (T1 thru T4) of AX+B type, as specified by customer. Option –11 must be installed in the data logger if thermocouple scales are included.
2240B-27 Engineer Units Notation	Notation only for T1 thru T4			As selected by customer.	Yes	Provides choice of printer notation, combining one from Column 17 plus one from Column 18: Column 17 Column 18 DC °F V si AC dB ohm F k μ (micro) lb W M G Hz A m (blank) s (blank) p kg c² mA °C (blank) % (blank)

Option —27
Engineering Units Notation

627-1. INTRODUCTION

627-2. The basic Model 2240B Data Logger measures, records, and displays channel input data in terms of dc voltage. Depending on the range selected, the data is displayed in either millivolts or volts. Analog input signals produced by external transducers, however, may represent any physical or electrical parameter such as pressure, temperature, flow, strain, etc. If proper signal conditioning and the appropriate scaling options are used, the data logger will measure, scale and record data directly in the proper engineering units, e.g., °C, °F, psi, %, etc. Compatible transducers include thermocouples, thermistors, resistance temperature detectors (RTD's) or any device whose output is a dc voltage (1 μV to 40V) or dc current. Measuring, recording and displaying data directly in terms of the transducer measurement unit requires adding one or more of the available scaling options to the 2240B Data Logger as shown in Table 627-1.

627-3. The —11 Temperature and Current Transmitter Option consists of an analog temperature pcb which attaches to the A/D Converter; a linearization ROM which contains the linearization program for the microprocessor; linearization tables for the various thermocouple types; an optional PROM which contains linearization tables for RTD's and current transmitters, and/or type E, B, C, G, and D thermocouples; and a configuration PROM which relates front panel programming via data entry keys T1, T2, T3 and T4 to the proper linearization table, A/D converter range and engineering units.

627-4. The —25 Custom Scaling Option, operating in place of the —11 Temperature and Current Transmitter Option, allows the customer to specify one custom scaling for data logger inputs from transducers other than the J, K, T, R, S thermocouples.

627-5. The —26 Multiple Scaling Option is a plug-in option that operates similar to the —25 Option. Basically, the Multiple Scaling Option allows selection of more than one custom scaling table. Depending on customer selection at time of purchase, the —26 Option provides up to four AX+B scalings per data logger in any combination.

627-6. Refer to Section 6 of the data logger manual for detailed information including specifications, operating instructions, theory of operation and maintenance, for the —11 Temperature and Current Transmitter Option, —25 Temperature and Single Scaling Option, and —26 Multiple Scaling Option.

627-7. DESCRIPTION

627-8. The —27 Engineering Units Notation Option allows customer choice of display annunciator, decimal point position and printer annunciator for data logger front panel functions T1, T2, T3 and T4. The Engineering Unit Notation Option applies only to actual units notation, such as mV, mA, psi and %, and not to any scaling or changing of numbers. If the application requires converting or scaling a transducer input voltage (to the data logger) to read out directly in the desired transducer units, the —11, —25, or —26 Options would also be required along with the —27 Option.

627-9. For example, if a transducer provides a 0 to 200 mV output for a 0 to 1000 psi input, Option —27 (Engineering Units Notation) could merely change the mV to psi on the assigned "T" function. If exact correlation is required (i.e., 200 mV in reads 1000 psi) scaling is necessary. Either the —25 or —26 Options, along with the —27 Option would be used to provide the scaling to change 200 mV to 1000 psi.

627-10. SELECTION OF ENGINEERING UNITS NOTATION

627-11. Specifying Engineering Units Notation involves several considerations, including selection of desired units, selection of decimal point location for both display and printout, selection of display annunciator and selection of A D converter range, depending on the particular data logger application

627-12. If the Engineering Units Notation Option is to be used without the - 25 Temperature and Single Scaling Option (special custom scaling of the transducer input not required), the following steps are required to adequately define the - 27 Option parameters for each data logger input requiring notation:

a. Specify desired choice of notation, one from column 17 and one from column 18.

Column 17		**Column 18**	
DC	°F	V	si
AC	dB	ohm	F
k	μ	lb	W
M	G	Hz	A
m	(Blank)	s	(Blank)
p	kg	C^2	mA
°C	(Blank)	%	(Blank)

Examples: **Column 17** **Column 18**

m + W = mW

Blank + mA = mA

p + si = psi

b. Select Decimal Point Location:
   1. xxxx.x
   2. xxx.xx
   3. xx.xxx
   4. x.xxxx
   5. xxxxx

c. Select Display Annunciator
   1. Temperature
   2. Millivolts
   3. Volts
   4. Time
   5. (Blank)

d. Select Range
   1. 40 mV
   2. 400 mV
   3. 4V
   4. 40V.

   NOTE: 40 mV and 40V ranges require the —10 High Performance A/D Converter Option.

e. Select Front Panel Function location
   1. T1
   2. T2
   3. T3
   4. T4

627-13. If the Engineering Units Notation Option is to be used in conjunction with the —25 Option steps (b) through (d) should also be specified as part of the specification for the —25 Option.

627-14. SPECIFICATIONS

627-15. The —27 Engineering Units Notation Option is a custom function configuration program based on customer designated parameters. Basic data logger and data logger option specifications are unchanged with the inclusion of this option. Refer to Sections 1 and 6 for complete data logger specifications.

627-16. OPERATING INSTRUCTIONS

627-17. Operating instructions for data loggers equipped with the —27 option are the same as for the standard data logger with the addition of the customer specified T1, T2, T3 or T4 front panel functions. These functions will be designated by special markings on the front panel to indicate which units notation will be called when the corresponding function button is pressed. Refer to Section 2 for complete data logger operating instructions.

627-18. THEORY OF OPERATION

627-19. The basic theory of operation for the data logger is unchanged with the inclusion of the -27 Option. When the 27 Option is added to a data logger equipped with the —25 or —26 Options, the configuration PROM used will be programmed to reflect display annunciator, decimal point position and printer annunciator as specified by the customer. This PROM is used to characterize the functions T1, T2, T3, and T4. The configuration PROM, U12, is located on the Controller PCB.

627-20. Normally, Option —27 is not required when the data logger is equipped with Option —11. Notations of °C or °F are provided with Option —11.

627-21. MAINTENANCE

627-22. Standard data logger maintenance procedures apply to data loggers equipped with the —27 Engineering Units Notation Option. Refer to Section 5 of the data logger manual for complete maintenance information.

627-23. LIST OF REPLACEABLE PARTS

627-24. IC U12 is programmed and labeled in accordance with customer specifications. When replacement is necessary special markings from the original part must accompany the order.

CAUTION

IC U12 is subject to damage by static discharge.

Table 627-1. Data Logger Measurement and Scaling Options

OPTION	COMPATIBLE TRANSDUCERS			READOUT	FACTORY INSTALLED OPTION ONLY	REMARKS
	Thermocouples	RTD's	Current Transmitters			
2240B-11 Temperature and Current Transmitter Option	J, K, T, R, S, E, B, C, G, D (W3, J-DIN, K-DIN, S-DIN, T-DIN	385 Platinum 392 Platinum	1-5 mA, 4-20 mA, 10-50 mA Scaled 0 to 100%	Thermocouples and RTD's in °C or °F, Current Transmitters in %	Yes	Provides up to four transducer inputs (T1 thru T4) selected in any combination. °C or °F selected by a switch on the Controller PCB. Readout in units other than % for Current Transmitters or °C/°F for temperature requires addition of Option –27.
2240B-25 Temperature and Single Scaling Option	Any three J, K, T, R, or S thermocouple, plus one custom transducer with an output in the range of 1 μV to 40V dc or current (when using Options –28, –29, or –30).			As specified by customer	Yes	Provides one custom linear scaling for transducer input specified by the customer.
2240B-26 Multiple Scaling Option	Up to four custom scalings, AX+B type			As specified by customer.	Yes	Provides up to four scalings (T1 thru T4) of AX+B type, as specified by customer. Option –11 must be installed in the data logger if thermocouple scales are included.
2240B-27 Engineer Units Notation	Notation only for T1 thru T4			As selected by customer.	Yes	Provides choice of printer notation, combining one from Column 17 plus one from Column 18: Column 17 — Column 18 DC °F — V si AC dB — ohm F k μ (micro) — lb W M G — Hz A m (blank) — s (blank) p kg — c² mA °C (blank) — % (blank)

-33 Option
Eight Channel RTD Scanner

633-1. INTRODUCTION

633-2. The RTD Scanner (Option -33) is an eight-channel, two-wire relay scanner which operates in conjunction with the 2200 series data logger and an RTD Input Connector (2200A-03) to provide excitation current and multiplex switching for up to eight RTD (resistance-temperature-device) inputs. The scanner can be installed in any one of the available scanner pcb slots in the data logger or an associated scanner chassis. Scanner input connections for the RTD's are accomplished using the 2200A-03 RTD Input Connector. When a channel is selected, reed relays in the scanner connect the RTD input to the data logger's analog bus. At the same time an on-board reference supply is energized to supply an adjustable excitation current (1 mA nominal) to the selected RTD. The resultant I-R drop is measured as a voltage and displayed in terms of temperature by the data logger.

633-3. SPECIFICATIONS

633-4. Specifications for the RTD Scanner are given in Table 633-1.

633-5. INSTALLATION

633-6. The Eight Channel RTD Scanner can be installed in any one of the scanner locations in a 2200B/2240B Data Logger. Use the following procedure to install a scanner.

WARNING

REMOVE LINE-POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

a. Remove the top cover and the inner top-guard cover from the data logger.

CAUTION

Handle the scanner pcb by its edges to avoid contaminating the pcb with oil from the hands. The use of gloves is recommended.

b. Select the location that includes the block of channels the scanner is to represent and align the scanner in the slot so that the large board-edge connector is toward the rear of the unit and the small offset board-edge connector is toward the bottom of the unit. Push the scanner straight down onto the mating connectors.

c. Prior to use, test and calibrate the scanner using the procedures given later under maintenance.

d. Install the inner guard cover and the top cover.

633-7. OPERATION

633-8. Once installed in the data logger the Eight-Channel RTD Scanner requires no operator attention. However, certain considerations are necessary to properly interface the scanner with the RTD's. These considerations are discussed in the following paragraphs.

633-9. Input Connections

633-10. The 2200/2240 series data loggers accept three types of input connectors depending on the type of scanner in use. The General Purpose and Low Level Scanners are compatible with both the -07 Solder Pin Connector and -08 Isothermal Connector. Refer to Option -07 and -08 subsections in Section 6 of the data logger manual for instructions covering hookup and installation of these connectors. The RTD Scanner is only compatible with the RTD Connector. Refer to Option -03 subsection in Section 6 of this manual for RTD Connector hookup and installation instructions. Refer to the following paragraphs for applications information concerning three- and four-terminal RTD measurements.

Table 633-1. RTD Scanner Specifications

RTD Channels: 8

Ice-Point Resistance (standard): 100Ω ±0.8%

Temperature Range: −200°C to + 775°C, −328°F to +1427°F

Linearization Conformity: 0.035°C or 0.063°F

Resolution: 0.1°C or 0.1°F

System Accuracy: NOTE: Specifications do not include sensor error.

	TEMP RANGE	90-DAY 25 ±5°C SLOW	1-YEAR 25 ±10°C FAST	1-YEAR 25 ±10°C SLOW
High Performance A/D (−10)	−200°C to −450°C	0.3°C	0.4°C	0.4°C
	−450°C to +800°C	0.3°C	0.4°C	0.6°C
	−328°F to +700°F	0.6°F	0.7°F	0.8°F
	+700°F to +1472°F	0.6°F	0.8°F	1.0°F
General Purpose A/D (−09)	−200°C to +400°C	0.4°C	N/A	0.5°C
	+400°C to +800°C	0.6°C	N/A	0.7°C
	−328°F to +800°F	0.7°F	N/A	0.8°F
	+800°F to +1472°F	1.0°F	N/A	1.2°F

Slow: 2.5 Rdgs/Sec
Fast: 15 Rdgs/Sec

633-11. Input Pin Assignments

633-12. The pin assignments for the rear panel, card-edge connector of the RTD Scanner are shown in Figure 633-1. Since contact with signals on this connector are completed through the -03 RTD Connector, to the -03 Option subsection in this manual for pin assignments available for fabricating RTD interface cables.

633-13. Four-Terminal Measurements

633-14. Four-terminal RTD's must be connected to the scanner in true four-terminal configuration to achieve full accuracy from the system. Four-terminal RTD's are supplied by the manufacturer with four leads, usually two of one color and two of another. (Color code and other identifying marks on RTD's vary with the manufacturer.) The two leads with a common connection at one end of the RTD should be connected to the HI and +S terminals of the RTD Connector and the remaining two leads should be connected to the LO and −S (sense terminals) of the RTD Connector. Figure 633-2 shows an example of four-terminal RTD connections to channel 0 (CH0) and channel 1 (CH1) of the RTD Connector with the RTD's having four wires, two red and two white.

	TOP		
H0	A	1	H0
+S0	B	2	−S0
H1	C	3	L1
−S1	D	4	+S1
L2	E	5	H2
+S2	F	6	−S2
H3	H	7	L3
−S3	J	8	+S3
—	K	9	—
—	L	10	+S4
SHIELD	M	11	—
L4	N	12	H4
−S5	P	13	+S5
H5	R	14	L5
+S6	S	15	−S6
L6	T	16	H6
−S7	U	17	+S7
H7	V	18	L7
NC	W	19	NC
↕	X	20	↕
↕	Y	21	↕
NC	Z	22	NC

Figure 633-1. RTD Scanner Rear Panel Connector Pin Assignments

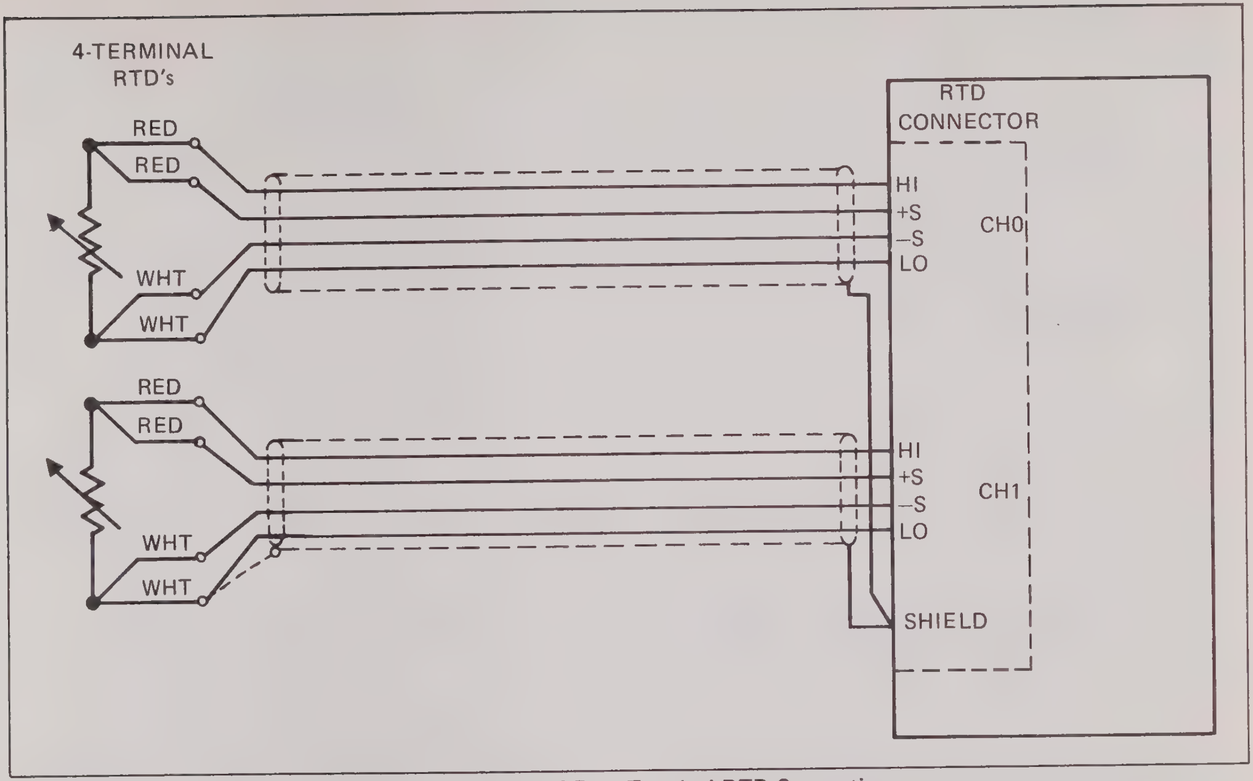


Figure 633-2. Example of Four-Terminal RTD Connections

Additional four-terminal RTD's would be connected in exactly the same manner to HI, LO, +S and -S terminals of any other available channels in the RTD Connector, up to a maximum of eight per scanner. When shielded input cables are used, best results are usually obtained by connecting all of the shields on the block to the common shield terminal. The best common mode rejection performance is usually obtained by connecting only one of these shields to the LO terminal at the RTD. When no shields are used, connect the shield input to the LO input of one of the channels.

633-15. It is important to note that four individual wires must be brought out from the scanner to connect to each four-terminal RTD, as shown in the diagram, to achieve true four-terminal RTD measurements. Connecting HI to +S and LO to -S at the scanner and extending two wires only for connection to the RTD will not provide a four-terminal measurement because sensing in not taking place at the RTD. Such a two-wire hookup actually comprises a two-terminal measurement configuration, introducing associated lead resistance error into the measurement.

633-16. Three-Terminal Measurement

633-17. Three-terminal RTD's should be connected to the scanner as shown in Figure 633-3. In this hookup, the scanner LO and -S terminals are brought out to the RTD and connected to the common third wire of the RTD. The HI and +S terminals are connected individually to the remaining two RTD wires in the same manner as in the four-terminal hookup.

NOTE

Lead wire resistance errors are introduced by the resistance of the common or third wire of the RTD. For this reason the independent connection of -S and LO terminal should be made as close to the RTD sensing element as possible.

633-18. THEORY OF OPERATION

633-19. The RTD Scanner contains 11 form-A, double pole reed relays. A contact pair from eight of the relays, K0 through K7, is connected to two separate busses (one pole to each bus) to form a two-pole, eight-channel scanner complete with treeing relay, K10. The treeing relay operates when any one of the channel relays is operated. It is used to connect the scanner busses to the input of the data logger's A/D converter. Relay K11 operates in parallel with K10 to connect the scanner's shield to the data logger's guard. The remaining relay, K9, switches the output of the +10V reference supply onto the analog bus for measurement purposes. It is energized whenever channel 8 or 9 is selected on the

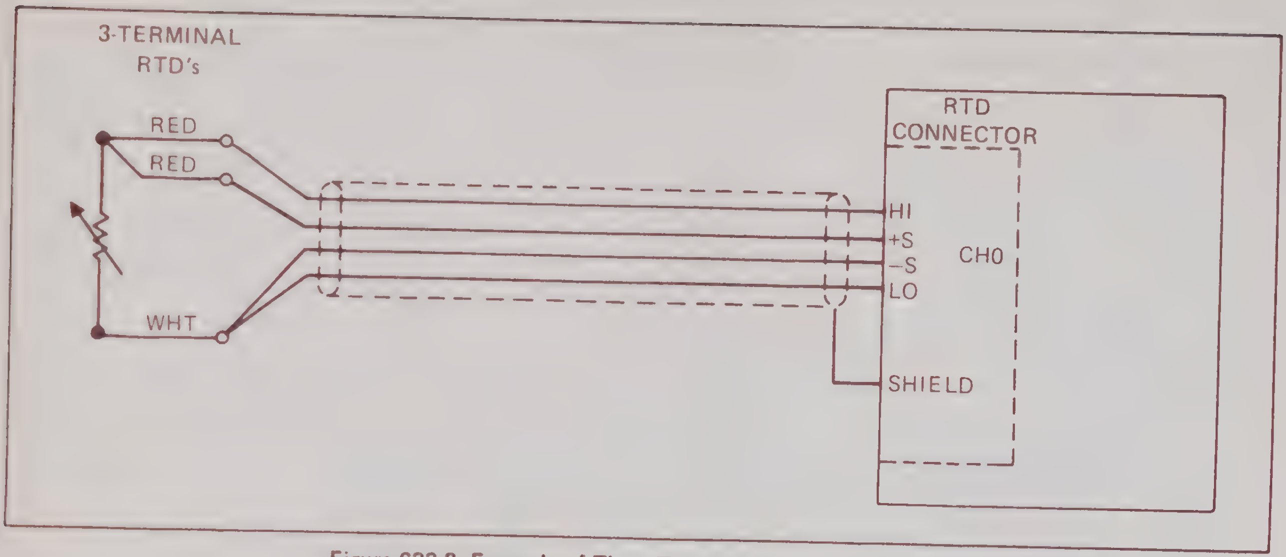


Figure 633-3. Example of Three-Terminal RTD Connections

scanner. A bcd-to-decimal decoder, U1, operates in conjunction with Q7 through Q15 to select the desired channel.

633-20. Excitation current (≈ 1 mA) for the RTD's is supplied by an on-board 10 volt precision power supply. The supply is powered by the guarded logic +5 volts supply (GL+5V) in the data logger. An inverter and a regulator on the scanner are used to generate the +10V dc output.

633-21. The power supply consists of a high frequency inverter (T1, Q1, Q2, CR1, CR2), a +15V dc regulator (U2A, Q3, Q4, CR5) and a +10V dc regulator (U2B). The inverter is energized whenever a channel on the scanner is called. This provides the two regulators with isolated ac operating voltage by way of the transformer, T1, secondary winding. The voltage is rectified and filtered before being presented to the regulator as unregulated dc power. A conventional series-pass regulator is used to establish a stable supply for operating dual op amp U2. One half of U2 is used control the +15V dc regulator. The other half is used as a feed-back amplifier to provide the +10V dc output. Both the +10 and +15V supplies use CR5 as a voltage reference.

633-22. The output of the +10V supply is applied through a precision wirewound resistor and potentiometer in each RTD input channel to the +S terminal (+source). Three other input terminals, -S (-source), HI, and LO operate with the +S terminal to provide true four-terminal ohms measurement capability. The potentiometer on each channel allows the RTD current to be adjusted for calibration purposes.

633-23. MAINTENANCE

633-24. Access Information

633-25. Refer to the installation information given in this option subsection for access information. Remove the rear panel input connector before attempting to remove the scanner pcb from the data logger.

633-26. Performance Test

633-27. The performance test is designed to verify the overall operation of the Eight-Channel RTD Scanner and is intended for use as an acceptance test and/or periodic maintenance check. The equipment used in the test is specified in Table 633-2. If the scanner fails any part of the test, corrective action is required.

a. Turn data logger power off and disconnect the power cord from the ac line.

b. Install the Eight-Channel RTD Scanner being tested in Block 0 of the data logger.

c. Connect a 100Ω ±0.1% resistor between the +S and -S terminals of each channel (0-7) on the RTD Input Connector (Option -03).

d. Using bare hookup wire, connect HI to +S and LO to -S on each channel of the test connector.

e. Install the RTD test connector on the RTD Scanner in Block 0 of the data logger.

f. Connect the data logger to line power and set the power switch to POWER ON.

g. Program the data logger to read the voltage present at channel 9. It should read 10.000 ±0.01V dc. This is the +10 volt reference supply. If the reading is not correct, complete the power supply calibration adjustment procedure (given later in this subsection) before proceeding.

h. Program the data logger to monitor the voltage at channel 0. The voltage should read approximately +100 mV dc.

i. Refer to Figure 633-4 and verify that the channel 0 potentiometer (R25) can be adjusted over a minimum range of 99.1 to 100.9 mV. Leave the adjustment set for a data logger indication of 100.00 mV.

j. Repeat steps h and i of this procedure for channels 1 through 7.

k. Program the data logger to scan and record the voltage at channels 0 through 7. Each reading should indicate 100.00 ±0.02 mV.

l. Turn data logger power off and disconnect the power cord from the ac line.

m. Disconnect the test connector and remove the scanner. This completes the performance test.

Table 633-2. Required Test Equipment

INSTRUMENT	RECOMMENDED MODEL
Data Logger	Fluke 2200B/2240B
Input Connector	Fluke Model 2200A-03
Resistors (8 each) (1)	100Ω ±0.1%, ¼ watt
Thermos Bottle (2)	1 pint for 0°C ice-point bath
RTD's (2)	RTD's that will be used with the –33 Scanner

(1) Used only in Performance Test
(2) Used only in Calibration Adjustments Procedure

633-28. Calibration Adjustments

633-29. The Eight-Channel RTD Scanner should be calibrated when it is initially installed in a data logger, and whenever the data logger is calibrated. Calibration adjustments for the scanner are shown in Figure 633-4. The procedure assumes that the data logger and the a/d converter calibration procedures have been competed and that the scanner is installed in its assigned location.

633-30. +10 VOLT REFERENCE

633-31. Use the following procedure to adjust the +10 volt reference supply:

a. Program the data logger to monitor the voltage on channel 9 of the scanner pcb being checked; use the 40V range. The voltage reading should be 10.000 ±0.010V dc.

b. If the reading is not within limits, adjust R9 on the scanner pcb for a reading of 10.000 ±0.002V dc.

633-32. RTD CURRENT ADJUSTMENTS

633-33. Each RTD channel that is equipped with an RTD input must be calibrated when the RTD is connected. Calibration is accomplished by making screwdriver adjustments on the scanner pcb. These adjustments set the RTD excitation current so that a known I-R (voltage) is produced across the RTD at a known temperature (0° C).

a. Determine the location of the scanner to be calibrated and attach its RTD's using the RTD Input Connector.

NOTE

RTD's are assumed to have a resistance 100Ω ±0.8% at 0° C.

b. Remove the top cover and the inner guard cover from the data logger.

c. Prepare a 0°C (32°F) ice-point bath using a 1 pint thermos bottle.

d. Place each RTD to be calibrated in the ice-point bath and allow the RTD temperature to stabilize.

e. Monitor each scanner channel and adjust the appropriate potentiometer (see Figure 633-4) for a reading of 00.0°C (32.0°F) on the RTD measurement function or 100.00 on the 400 mV range.

f. Install the top and inner guard covers after the calibration adjustments have been completed.

633-34. LIST OF REPLACEABLE PARTS

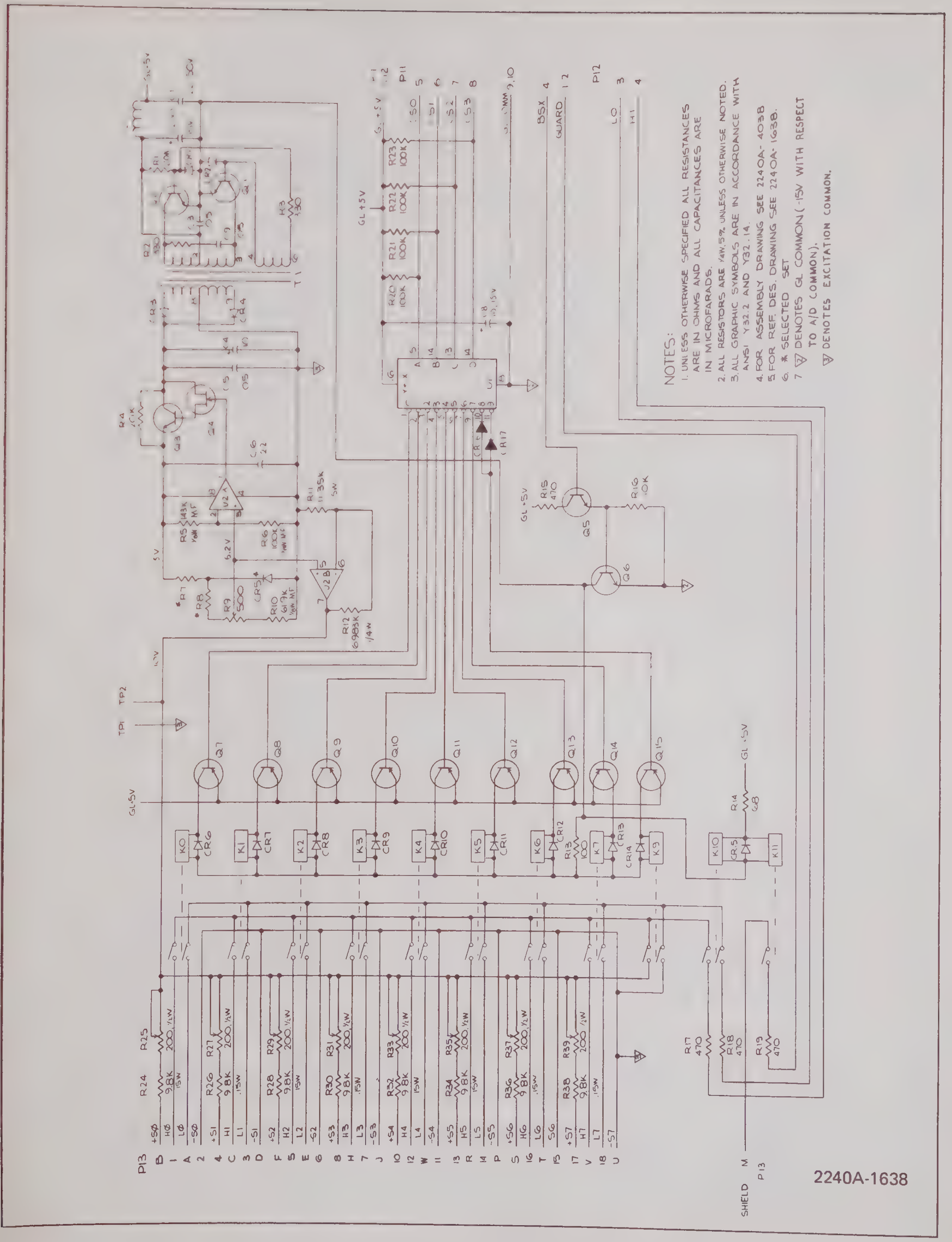
633-35. A list of replaceable parts for the Eight-Channel RTD Scanner is given in Table 633-3. Refer to Section 5 of this manual for ordering information.

Table 633-3. Eight Channel RTD Scanner

ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	EIGHT CHANNEL RTD SCANNER, OPTION -33 (2240A-4038) FIGURE 633-4						
C1	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	2		
C2	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	2		
C3	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	3		
C4	CAP, TA, 10 UF +/-20%, 35V	417683	56289	196D106X0035PE4	1		
C5	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	REF		
C6	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C8	CAP, TA, 10 UF +/-20%, 15V	193623	56289	196D106X0015KA1	REF		
C9	CAP, CER, 0.05 -20/+80%, 25V	148924	72982	5855-000-Y5U0-503Z	REF		
CR1	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	16	6	
CR2	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR3	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR4	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR5	ZENER REFERENCE SET (INCLUDES RESISTORS R7 AND R8)	377283	89536	377283	1		
CR6	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR7	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR8	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR9	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR10	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR11	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR12	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR13	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR14	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR15	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR16	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
CR17	DIODE, SI, HI-SPEED SWITCH	203323	07910	1N4448	REF		
H1	TRANS-PAD	152207	07047	10123-DAP	1		
K0	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	11		
K1	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K2	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K3	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K4	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K5	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K6	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K7	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K9	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K10	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
K11	RELAY, REED, 2-POLE, FORM-A	442921	21317	052A5*300BAA	REF		
L1	INDUCTOR, 6-TURN	320911	89536	320911	1		
Q1	XSTR, SI, NPN	272237	89536	272237	3	1	
Q2	XSTR, SI, NPN	272237	89536	272237	REF		
Q3	XSTR, SI, NPN	272237	89536	272237	REF		
Q4	XSTR, J-FET, N-CHANNEL	261388	89536	261388	1	1	
Q5	XSTR, SI, NPN	218396	04713	2N3904	1	1	
Q6	XSTR, SI, NPN	182196	89536	182196	1	1	
Q7	XSTR, SI, PNP	195974	04713	2N3906	9	2	
Q8	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q9	XSTR, SI, PNP	195974	04713	2N3906	REF		

Table 633-3. Eight Channel RTD Scanner (cont)

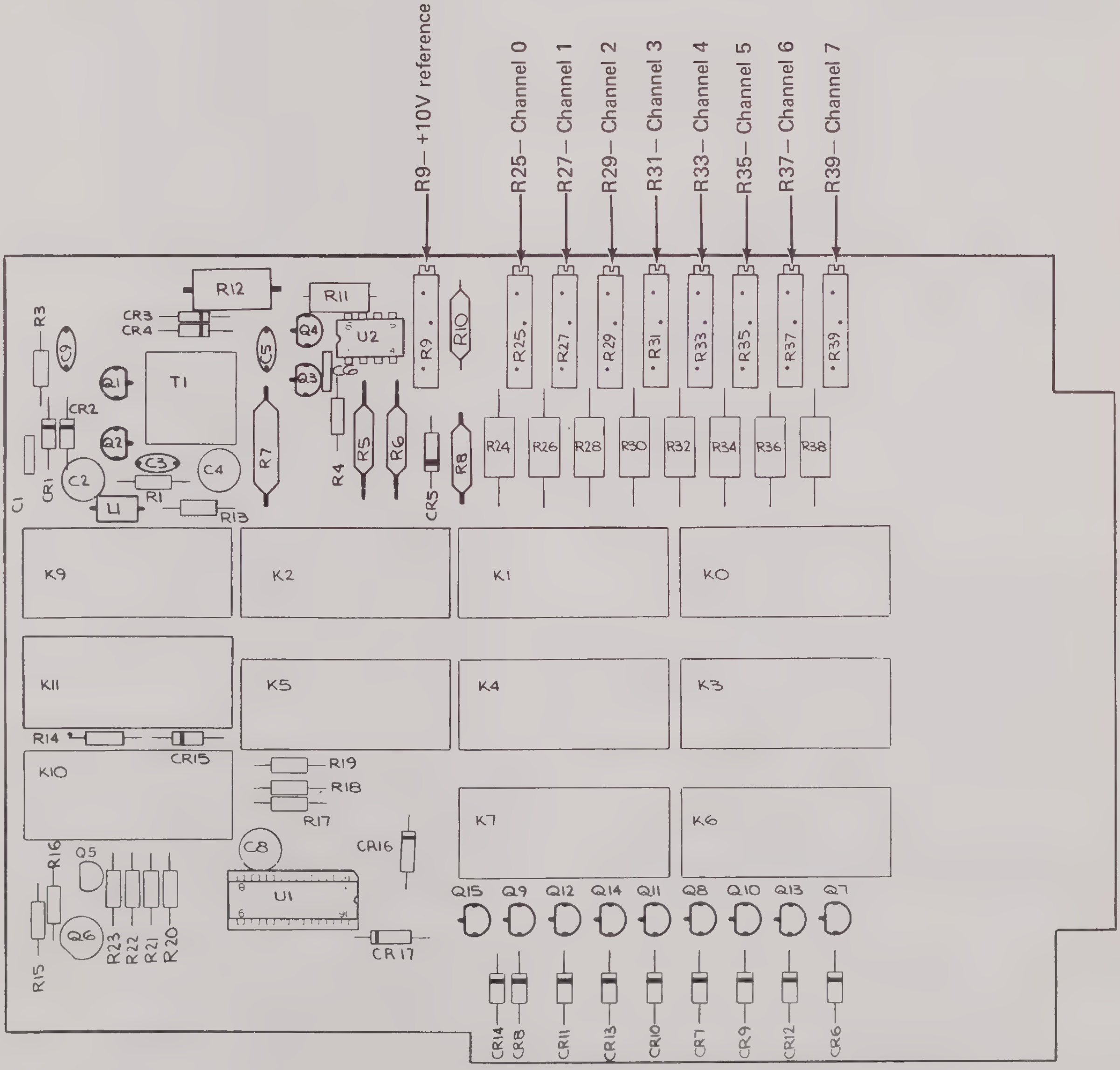
ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q10	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q11	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q12	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q13	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q14	XSTR, SI, PNP	195974	04713	2N3906	REF		
Q15	XSTR, SI, PNP	195974	04713	2N3906	REF		
R1	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	2		
R2	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	2		
R3	RES, DEP. CAR, 330 +/-5%, 1/4W	368720	80031	CR251-4-5P330E	REF		
R4	RES, DEP. CAR, 20K +/-5%, 1/4W	441477	80031	CR251-4-5P20K	REF		
R5	RES, MF, 143K +/-1%, 1/8W	291336	91637	CMF551433F	1		
R6	RES, MF, 100K +/-1%, 1/8W	248807	91637	CMF551003F	1		
R7	SEE CR5				REF		
R8	SEE CR5				REF		
R9	RES, VAR, 1K +/-10%, 1/2W	267856	89536	267856	1	1	
R10	RES, MF, 61.9K +/-1%, 1/8W	237230	91637	CMF556192F	1		
R11	RES, WW, 11.35K +/-0.1%, 0.15W	385542	89536	385542	1	1	
R12	RES, WW, 6.983K +/-0.05%, 1/4W	292896	89536	292896	1	1	
R13	RES, DEP. CAR, 100 +/-5%, 1/4W	348771	80031	CR251-4-5P100E	1		
R14	RES, DEP. CAR, 68 +/-5%, 1/4W	414532	80031	CR251-4-5P68E	1		
R15	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	4		
R16	RES, DEP. CAR, 10K +/-5%, 1/4W	348839	80031	CR251-4-5P10K	1		
R17	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R18	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R19	RES, DEP. CAR, 470 +/-5%, 1/4W	343434	80031	CR251-4-5P470E	REF		
R20	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	4		
R21	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R22	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R23	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	REF		
R24	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	8	2	
R25	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	8	2	
R26	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R27	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R28	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R29	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R30	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R31	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R32	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R33	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R34	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R35	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R36	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R37	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
R38	RES, WW, 9.8K 0.1%, 0.15W	446484	89536	446484	REF		
R39	RES, VAR, 200 +/-20%, 1/2W	284711	11236	190PC201B	REF		
T1	XFMR, INVERTER	462093	89536	462093	1		
U1	IC, C-MOS, BCD-TO-DECIMAL DECODER	407981	12040	MM74C42N	1		
U2	IC, LINEAR, OP AMP (SELECTED)	418566	89536	418566	1	1	
XU1	SOCKET, IC, 16-PIN DIP	370312	91506	316-AG39D	1		


P13
+S0 H0 L0 -S0 +S1 H1 L1 -S1 +S2 H2 L2 -S2 +S3 H3 L3 -S3 +S4 H4 L4 -S4 +S5 H5 L5 -S5 +S6 H6 L6 -S6 +S7 H7 L7 -S7
R24 9.8K .15W
R25 200 1/2W
R26 9.8K .15W
R27 200 1/2W
R28 9.8K .15W
R29 200 1/2W
R30 9.8K .15W
R31 200 1/2W
R32 9.8K .15W
R33 200 1/2W
R34 9.8K .15W
R35 200 1/2W
R36 9.8K .15W
R37 200 1/2W
R38 9.8K .15W
R39 200 1/2W
R17 470
R18 470
R19 470
SHIELD M P13
K0 CR6 K1 CR7 K2 CR8 K3 CR9 K4 CR10 K5 CR11 K6 CR12 K7 CR13 CR14 K9 K10 CR15 K11
R13 100
R14 68
GL -5V
GL+5V
Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15
TP1 TP2
R4 4.7K
Q3 Q4
C6 22
C5 .05
C4 10
R5 143K 1/8W MF
R6 100K 1/8W MF
U2A U2B
R11 11.35K 5W
R7 R8 R9 500 R10 61.9K 1/8W MF
R12 6983K 1/4W
CR5 6.2V
CR3 CR4
R1 10K R2 330 R3 330
Q1 Q2 T1
R20 100K R21 100K R22 100K R23 100K
GL+5V
U1
CR16 CR17
GL+5V R15 470 Q5 R16 10K Q6
P11 S0 S1 S2 S3 BSX GUARD
P12 LO HI
2240A-1638

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
3. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.
4. FOR ASSEMBLY DRAWING SEE 2240A-4038
5. FOR REF. DES. DRAWING SEE 2240A-1638.
6. * SELECTED SET
7. ▽ DENOTES GL COMMON (-15V WITH RESPECT TO A/D COMMON).
   ▽ DENOTES EXCITATION COMMON.

Figure 633-4. Eight Channel RTD Scanner PCB Assembly


R9— +10V reference
R25— Channel 0
R27— Channel 1
R29— Channel 2
R31— Channel 3
R33— Channel 4
R35— Channel 5
R37— Channel 6
R39— Channel 7
R12
R11
R3
CR3
CR4
C9
Q4
U2
C5
R10
R9
R25
R27
R29
R31
R33
R35
R37
R39
Q1
T1
Q3
CR2
Q2
R7
R5
R6
R4
CR5
R8
R24
R26
R28
R30
R32
R34
R36
R38
C3
C4
C2
CR1
C1
R1
U1
R13
K9
K2
K1
K0
K11
K5
K4
K3
R14
CR15
K10
R19
R18
R17
K7
K6
CR16
C8
Q5
R16
U1
Q6
R15
R23
R22
R21
R20
CR17
Q15
Q9
Q12
Q14
Q11
Q8
Q10
Q13
Q7
CR14
CR8
CR11
CR13
CR10
CR7
CR9
CR12
CR6

2240A-1038

Figure 633-5. Eight Channel RTD Scanner PCB Assembly (cont)

Option -34
Alarm Set Point

634-1. INTRODUCTION

634-2. The Alarm Set Point, Option -34, provides the 2200B Data Logger with the capability of establishing up to 40 unique limit values. The limit values are programmable and may be assigned to either 10 individual channels or to 10 blocks (10 channels per block) depending upon the selected 2200B programming mode, individual or block. In the individual mode (see Section 2), four limit values may be programmed for each of channels 0 through 9. Channels 10 through 99 assume the limit values that are assigned to channel 9. In the block programming mode, four limit values may be programmed for each of the 10 possible blocks, 0 through 9.

634-3. Limit values are programmed during a channel/block programming sequence, and consist of sense (>,<, skip), polarity (+, –,) and a four-digit numeric value (0000 to 3999). The least-significant digit (fifth digit) cannot be programmed and is, therefore, always 0 (zero). Thus, a programmed limit value of 0297 is actually 2970.

634-4. SPECIFICATIONS

634-5. Specifications for the Alarm Set Point Option are as follows:

Programmable Limits: 40 total
Limits per Channel/Block: 4 maximum
Limit Value Data
  Sense: <, >, or Skip
  Polarity: + or –
  Digits: 0000 to 3999

634-6. INSTALLATION

634-7. The Alarm Set Point option must be installed at the factory or any one of the Fluke Technical Service Centers. Modification of the basic 2200B is not required since it contains the circuitry and front panel controls and indicators necessary to accommodate this option.

634-8. OPERATION

634-9. Once installed, the Alarm Set Point option requires no operator attention. Instructions for programming the limits from the front panel of the 2200B are contained in Section 2 of the 2200B Instruction Manual.

Option -37
IEEE Interface

637-1. INTRODUCTION

637-2. The IEEE Interface (Option 2200B-37) is a plug-in printed circuit board (pcb) designed to provide the interface necessary to output data to devices on the IEEE-488 Bus (IEEE Standard 488, Digital Interface for Programmable Instrumentation, hereafter referred to as IEEE-488) from a Model 2200B Data Logger. The option, along with an IEEE-488 Bus Interface Cable (not provided with this option), allows the 2200B Data Logger to communicate with a IEEE-488 Bus controller such as the Fluke Model 1720A. The pcb is field installable using procedures given later under Installation.

637-3. Operation of the IEEE Interface can be functionally divided into two sequences; Talk and Listen. The Listen function is limited to receiving a remote start command in the form of a Group Execute Trigger (GET) from the Bus Controller. GET initiates a single scan. The Talk function transfers output data (scan and measurement data) from the data logger to the IEEE-488 Bus.

637-4. The IEEE Interface consists of a single plug-in pcb which can be installed in any one of the three data logger I/O slots. Access to the IEEE-488 Bus is accomplished by a back panel cable and connector. Once the pcb is installed, the Data Logger IEEE-488 Bus address and mode of operation can be selected without removing the card from the data logger.

637-5. SHIPPING INFORMATION

637-6. The IEEE Interface is packaged and shipped in a protected shipping envelope. When you receive the IEEE Interface, inspect the instrument throughly for possible shipping damage. Special instructions for inspection and claims are included on the shipping container.

637-7. If reshipment is necessary, use the original container. If the original container is not available, order a new container from John Fluke Mfg. Co., Inc./P.O. Box 43210/Mountlake Terrace, Washington 98043 Telephone (206) 774-2211.

637-8. INSTALLATION

637-9. The IEEE Interface can be installed in any one of the data logger I/O slots shown in Figure 637-1. To install the pcb, use the following procedure:

WARNING

REMOVE LINE POWER AND ALL OTHER HIGH VOLTAGE INPUTS TO THE DATA LOGGER BEFORE STARTING THIS PROCEDURE.

1. Set the data logger POWER switch to OFF.
2. Remove the top cover from the data logger.
3. Remove the unguarded cover from the data logger.
4. Locate switch S2 on the pcb as shown in Figure 637-1. S2 is used to assign the IEEE-488 Bus address code to the pcb.
5. With reference to Table 637-1, set positions 1 through 5 of S2 to assign the desired address character.
6. Locate Switch S1 on the pcb as shown on Figure 637-1.

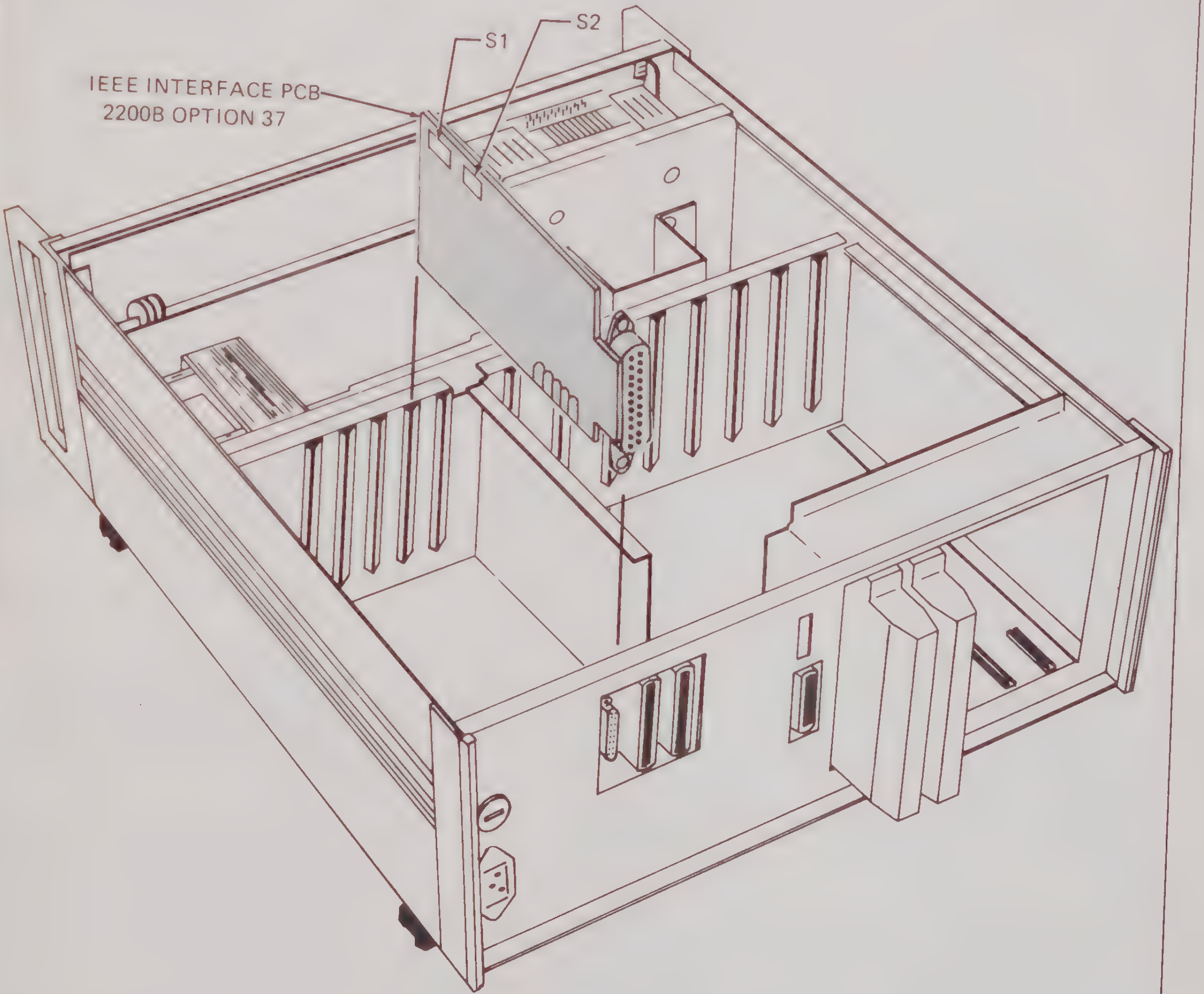

S1
S2
IEEE INTERFACE PCB
2200B OPTION 37

Figure 637-1. Installation and Switch Locations

Table 637-1. Switch S2, IEEE-488 Bus Address Selection

Talk Address = 1 0 X X X X X
Listen Address = 0 1 X X X X X
S2 Switch Setting = X X X X X
Switch ON = 1
OFF = 0

ADDRESS CODES		ADDRESS CHARACTERS		ADDRESS SWITCH SETTINGS				
DECIMAL	OCTAL	LISTEN	TALK	(5)	(4)	(3)	(2)	(1)
0	0	SP	@	0	0	0	0	0
1	1	!	A	0	0	0	0	1
2	2	''	B	0	0	0	1	0
3	3	#	C	0	0	0	1	1
4	4	$	D	0	0	1	0	0
5	5	%	E	0	0	1	0	1
6	6	&	F	0	0	1	1	0
7	7	'	G	0	0	1	1	1
8	10	(	H	0	1	0	0	0
9	11	)	I	0	1	0	0	1
10	12	*	J	0	1	0	1	0
11	13	+	K	0	1	0	1	1
12	14	,	L	0	1	1	0	0
13	15	—	M	0	1	1	0	1
14	16	.	N	0	1	1	1	0
15	17	/	O	0	1	1	1	1
16	20	0	P	1	0	0	0	0
17	21	1	Q	1	0	0	0	1
18	22	2	R	1	0	0	1	0
19	23	3	S	1	0	0	1	1
20	24	4	T	1	0	1	0	0
21	25	5	U	1	0	1	0	1
22	26	6	V	1	0	1	1	0
23	27	7	W	1	0	1	1	1
24	30	8	X	1	1	0	0	0
25	31	9	Y	1	1	0	0	1
26	32	:	Z	1	1	0	1	0
27	33	;	[	1	1	0	1	1
28	34	<	\	1	1	1	0	0
29	35	=	]	1	1	1	0	1
30	36	>	∧	1	1	1	1	0

7. Refer to Table 637-2 and set positions 1 thorugh 4 of S1 to define the mode of operation of the pcb.

8. Align the IEEE Interface in the selected I/O slot so that the female connector is toward the rear of the data logger, and the small board-edge connector is toward the bottom of the unit. Push the pcb straight down and into the mating connector.

9. After the pcb is installed, install the unguarded and top cover.

637-10. IEEE-488 BUS INTERFACE CABLE

637-11. The IEEE Interface is connected to devices on the IEEE-488 Bus by means of the IEEE-488 Bus Interface Cable. The cable conforms to IEEE-488 Bus standards and can be ordered in three different lengths; 1 meter (Y8001), 2 meters (Y8002), and 4 meters (Y8003).

637-12. OPERATING NOTES

637-13. The following paragraphs describe various conditions that should be considered before attempting to operate the IEEE Interface.

637-14. IEEE-488 Bus

637-15. IEEE-488 Bus is an interfacing arrangement suited for programmable measurement instrumentation systems. Sixteen bus transmission lines provide for all data and message transfer and control Bus lines are defined under the following three categories:

Table 637-2. Switch S1, Configuration/Interface Selection

SWITCH SLIDE	FUNCTION	ON	OFF
1	Talker Only Mode (ton)	Talker Only	Not enabled
2	Analog readings per line	4 RPL	1 RPL
3	SRQ Enable	Enabled	Not enabled
4	Not implemented	----------	----------
5	Not connected	----------	----------

1. Eight data bus lines (DI01-DI08) data or address information is carried on these lines in bit-parallel, byte-serial format. Information transfer on these lines is asynchronous and bidirectional.

2. Three handshake lines:

   a. DAV (Data Valid): Indicates to a receiver that data is available on the IO0 lines.

   b. NRFD (Not Ready For Data): Indicates whether all devices are ready to accept data.

   c. NDAC (Not Data Accepted): Indicates the acceptance of data by all devices.

3. Five bus management lines:

   a. ATN (Attention): When true (low), DI01-DI08 will carry addresses or commands; when false DI01-DI08 carry data.

   b. IFC (Interface Clear): When true, (low) enables the following states:

      Talker idle
      Serial Poll idle
      Listener idle

   c. SRQ (Service Request): Operates as described by SRQ switch operation. (Configuration/Interface Switch (S1) Operation: SRQ, S1-3).

   d. REN (Remote Enable): Not used in the 2200B-37.

   e. EOI (End or Identify): Set true (low) when the last byte of data is present on the IEEE-488 Bus. The 2240B-15 sets EOI true on LF (Line Feed).

637-16. A maximum of 15 devices may be interconnected on one continguous bus structure. These devices may perform any combination of the following functions; talk, listen, or control. Figure 637-2 illustrates typical connections on the IEEE-488 Bus. Table 637-3 defines remote message coding used on the bus.

637-17. Remote Scan Trigger

637-18. The IEEE Interface is capable of accepting a Group Execute Trigger (GET) from the bus controller which initiates a single scan. A single scan is intitated when; the IEEE Interface is addressed as a listener. The REMOTE pushbutton is depressed (ON). A GET signal is received from the controller. If SRQ is enabled and the IEEE Interface is not addressed to talk, an SRQ preceeds the current output data.

637-19. Output Format

637-20. Output format from the IEEE Interface is recorded at the IEEE-488 listen device in the standard format shown in Table 637-4. A switch (S1-2) on the IEEE Interface allows selection of either one or four measurement data readings per line. See Table 637-2.

637-21. Configuration/Interface Switch (S1) Operation

637-22. SRQ (SERVICE REQUEST)

637-23. When SRQ is enabled (switch S1-3 = ON) the IEEE Interface requests service from the IEEE-488 Bus controller when the IEEE Interface contains a complete data logger reading. Service is requested by asserting the SRQ bus management line low. The SRQ line is released by the IEEE Interface when the first data byte is transferred onto the IEEE-488 Bus from the output buffer. The IEEE Interface responds to a serial poll interrogation by a controller on the IEEE-488 Bus. The serial poll response can be a 41 hex code (ASCII "A") if the IEEE Interface has initiated the service request, or a 0 hex code (ASCII "null") if it had not. If the IEEE Interface has initiated an SRQ and the current reading has not been entirely read (through the terminating CR/LF characters) all data logger scanning stops. Scanning resumes when the complete current reading has been completely read. If the IEEE Interface is left in the talker active state (TACS) no SRQs will be generated for new "data logger" readings.

637-24. When SRQ is not enabled (S1-3 = OFF), the IEEE Interface continuously updates its output with the current reading until addressed as a talker. When addressed as a talker, the current reading is held. The data logger stops scanning until the full reading has been taken or an untalk signal to the IEEE Interface has been sent.

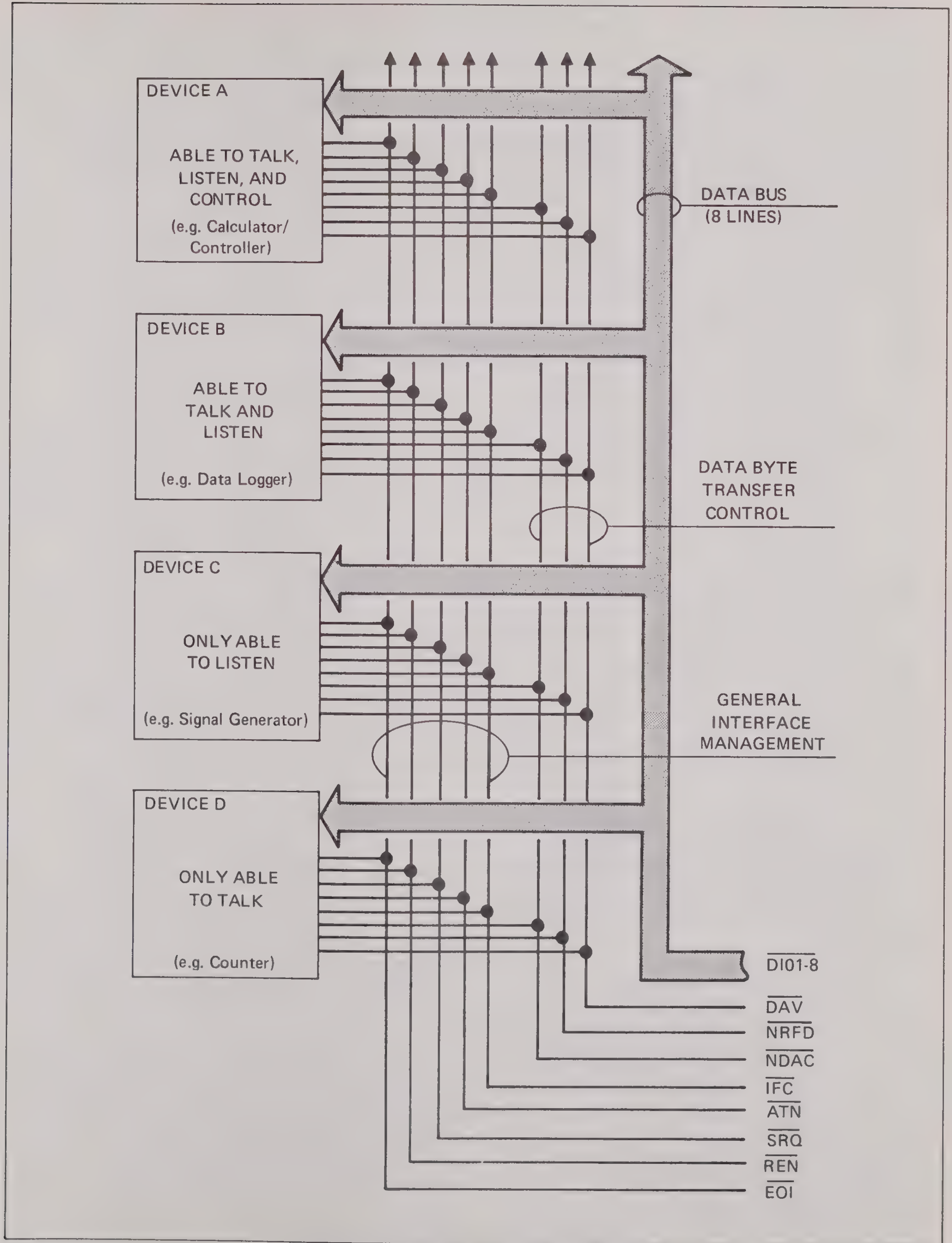

DEVICE A
ABLE TO TALK, LISTEN, AND CONTROL
(e.g. Calculator/ Controller)
DEVICE B
ABLE TO TALK AND LISTEN
(e.g. Data Logger)
DEVICE C
ONLY ABLE TO LISTEN
(e.g. Signal Generator)
DEVICE D
ONLY ABLE TO TALK
(e.g. Counter)
DATA BUS (8 LINES)
DATA BYTE TRANSFER CONTROL
GENERAL INTERFACE MANAGEMENT
$\overline{\text{DI01-8}}$
$\overline{\text{DAV}}$
$\overline{\text{NRFD}}$
$\overline{\text{NDAC}}$
$\overline{\text{IFC}}$
$\overline{\text{ATN}}$
$\overline{\text{SRQ}}$
$\overline{\text{REN}}$
$\overline{\text{EOI}}$

Figure 637-2. IEEE-488 Bus Connections

Table 637-3. Remote Message Coding

MNEMONIC	MESSAGE NAME	BUS SIGNAL LINE(S) AND CODING THAT ASSERT MESSAGE TRUE													MESSAGE TYPE	MESSAGE CLASS	NOTES
		DATA I/O								BUS MANAGEMENT							
		DI08	DI07	DI06	DI05	DI04	DI03	DI02	DI01	ATN	EOI	SRQ	IFC	REN			
ACG	Addressed Command Group	X	0	0	0	X	X	X	X	1	X	X	X	X	M	AC	
ATN	Attention	X	X	X	X	X	X	X	X	1	X	X	X	X	U	UC	
DAB	Data Byte	D8	D7	D6	D5	D4	D3	D2	D1	0	X	X	X	X	M	DD	1,6,7
DCL	Device Clear	X	0	0	1	0	1	0	0	1	X	X	X	X	M	UC	
END	End	X	X	X	X	X	X	X	X	0	1	X	X	X	U	ST	7
EOS	End of String	E8	E7	E6	E5	E4	E3	E2	E1	0	X	X	X	X	M	DD	2,7
GET	Group Execute Trigger	X	0	0	0	1	0	0	0	1	X	X	X	X	M	AC	
GTL	Go To Local	X	0	0	0	0	0	0	1	1	X	X	X	X	M	AC	
IDY	Identify	X	X	X	X	X	X	X	X	1	1	X	X	X	U	UC	
IFC	Interface Clear	X	X	X	X	X	X	X	X	X	X	X	1	X	U	UC	
LAG	Listen Address Group	X	0	1	X	X	X	X	X	1	X	X	X	X	M	AD	
LLO	Local Lock Out	X	0	0	1	0	0	0	1	1	X	X	X	X	M	UC	
MLA	My Listen Address	X	0	1	L5	L4	L3	L2	L1	1	X	X	X	X	M	AD	3
MTA	My Talk Address	X	1	0	T5	T4	T3	T2	T1	1	X	X	X	X	M	AD	4
MSA	My Secondary Address	X	1	1	S5	S4	S3	S2	S1	1	X	X	X	X	M	SE	5
NUL	Null Byte	0	0	0	0	0	0	0	0	0	X	X	X	X	M	DD	7
OSA	Other Secondary Address						(OSA = SCG ● MSA)								M	SE	
OTA	Other Talk Address						(OTA - TAG ● MTA)								M	AD	
PCG	Primary Command Group				(PCG = ACG + UCG + LAG + TAG)										M	–	
REN	Remote Enable	X	X	X	X	X	X	X	X	X	X	X	X	1	U	UC	
RQS	Request Service	X	1	X	X	X	X	X	X	0	X	X	X	X	U	ST	7
SCG	Secondary Command Group	X	1	1	X	X	X	X	X	1	X	X	X	X	M	SE	
SDC	Selected Device Clear	X	0	0	0	0	1	0	0	1	X	X	X	X	M	AC	
SPD	Serial Poll Disable	X	0	0	1	1	0	0	1	1	X	X	X	X	M	UC	
SPE	Serial Poll Enable	X	0	0	1	1	0	0	0	1	X	X	X	X	M	UC	
SRQ	Service Request	X	X	X	X	X	X	X	X	X	X	1	X	X	U	ST	
STB	Status Byte	S8	X	S6	S5	S4	S3	S2	S1	0	X	X	X	X	M	ST	6,7
TCT	Take Control	X	0	0	0	1	0	0	1	1	X	X	X	X	M	AC	
TAG	Talk Address Group	X	1	0	X	X	X	X	X	1	X	X	X	X	M	AD	
UCG	Universal Command Group	X	0	0	1	X	X	X	X	1	X	X	X	X	M	UC	
UNL	Unlisten	X	0	1	1	1	1	1	1	1	X	X	X	X	M	AD	
UNT	Untalk	X	1	0	1	1	1	1	1	1	X	X	X	X	M	AD	

SYMBOLS

Type	U = Uniline Message
	M = Multiline Message
Class	AC = Address Command
	AD = Address (Talk or Listen)
	DD = Device Dependent
	HS = Handshake
	UC = Universal Command
	SE = Secondary
	ST = Status

0 = Logical Zero (HIGH Signal Level)
1 = Logical One (LOW Signal Level)
X = Don't Care or Not Driven

NOTES

(1) D1-D8 specify the device dependent data bits

(2) E1-E8 specify the device dependent code used to indicate EOS message

(3) L1-L5 specify the device dependent bits of the device's listen address

(4) T1-T5 specify the device dependent bits of the device's talk address

(5) S1-S5 specify the device dependent bits of the device's secondary address

(6) S1-S6, S8 specify the device dependent status. (DI07 is used for the RQS message)

(7) The true message value must be ignored when received the LACS is inactive

Table 637-4. Standard Output Format

DESCRIPTION	OUTPUT DATA*																	
TIME OF YEAR	Y	SP	SP	SP	:	H	H	:	M	M	:	S	S	CR	LF			
DIGITAL INPUT DATA	D	AC	SP	SP	DD	DD	DD	DD	DD	DD	DD	DD	DD	CR	FL			
MEASUREMENT DATA	A	CH	CH	CH		±	9	9	9	.	9	9	*	*	0	L	CR	LF
	A	CH	CH	CH		±	7	7	7	.	7	7	*	*	B	T	CR	LF
	A	CH	CH	CH		±	AD	AD	AD	.	AD	AD	SP	C	SP	SP	CR	LF
	A	CH	CH	CH	>	±	AD	AD	AD	.	AD	AD	SP	F	SP	SP	CR	LF
	A	CH	CH	CH	<	±	AD	AD	AD	.	AD	AD	M	V	SP	SP	CR	LF
	A	CH	CH	CH	SP	±	AD	AD	AD	.	AD	AD	SP	V	SP	SP	CR	LF
DATA COLUMN ID (For Reference Purposes only-Not Recorded)	0	1	2	3	4 ①	5	6	7	8	9 ②	10	11	12	13	14	15	16	17

① These symbols occur in each row
② Floating decimal point, may occur in columns 7 - 10

*MNEMONICS
A = Measurement Data ID [ASCII A]
AC = Address Code [0 - 9]
AD = Analog Data [SP, 0 - 9]
CH = Channel No [SP, 0 - 9]
CR = Carriage Return
D = Digital Input ID [ASCII D]
DC = Day Code [0 - 9]
DD = Digital Input Data [0 - 9]
FD = Fixed Data [0 - 9]
H = Hours [00 - 23]
LF = Line Feed
M = Minutes [00 - 59]
S = Seconds [00 - 59]
SP = Space
X = Fixed Data ID [ASCII X]
Y = Time of Year ID [ASCII Y]
**OL = Overload
**BT = Broken Thermocouple
C = Degrees Celsius
F = Degrees Fahrenheit
MV = Millivolts
V = Volts

637-25. TON (TALKER ONLY)

637-26. When ton is enabled, (Switch S1-1 = ON) the IEEE Interface automatically enters the Talker Addressed State (TADS). To use this function, two switches must be set; the EXTERNAL ON switch and one of the Scan Control switches (SINGLE, INTERVAL, MONITOR, or CONTINUOUS) on the front panel of the 2200B.

637-27. Analog Readings Per Line

637-28. When Switch S1-2 is enabled (ON), a CR/LF character is appended to every fourth analog reading output to the IEEE-488 Bus. The 1st, 2nd, and 3rd analog readings are followed by two spaces.

637-29. OPERATION

637-30. Once installed, the IEEE Interface requires no operator attention other than ensuring that normal turn-on procedures are observed for both the data logger and devices on the IEEE-488 Bus. To initiate a Remote Scan, depress the REMOTE switch on the front panel. Each of the remote programming functions correspond to the manual functions described in Section 2 of the 2200B Instruction Manual.

637-31. THEORY OF OPERATION

637-32. The IEEE Interface, as shown in Figure 637-3 is a microprocessor based subsystem which functions as an A3 Controller peripheral to provide the interface necessary to output data to and from devices on the IEEE-488 Bus. Once devices on the IEEE-488 Bus have been defined, the IEEE Interface is tailored to meet the interface requirements by setting a series of switches on the pcb. (See Installation instructions for switch settings as they apply to this option). These settings are read by the MPU (Microprocessor Unit) and stored in the memory via the memory interface (U6) each time the data logger is turned on.

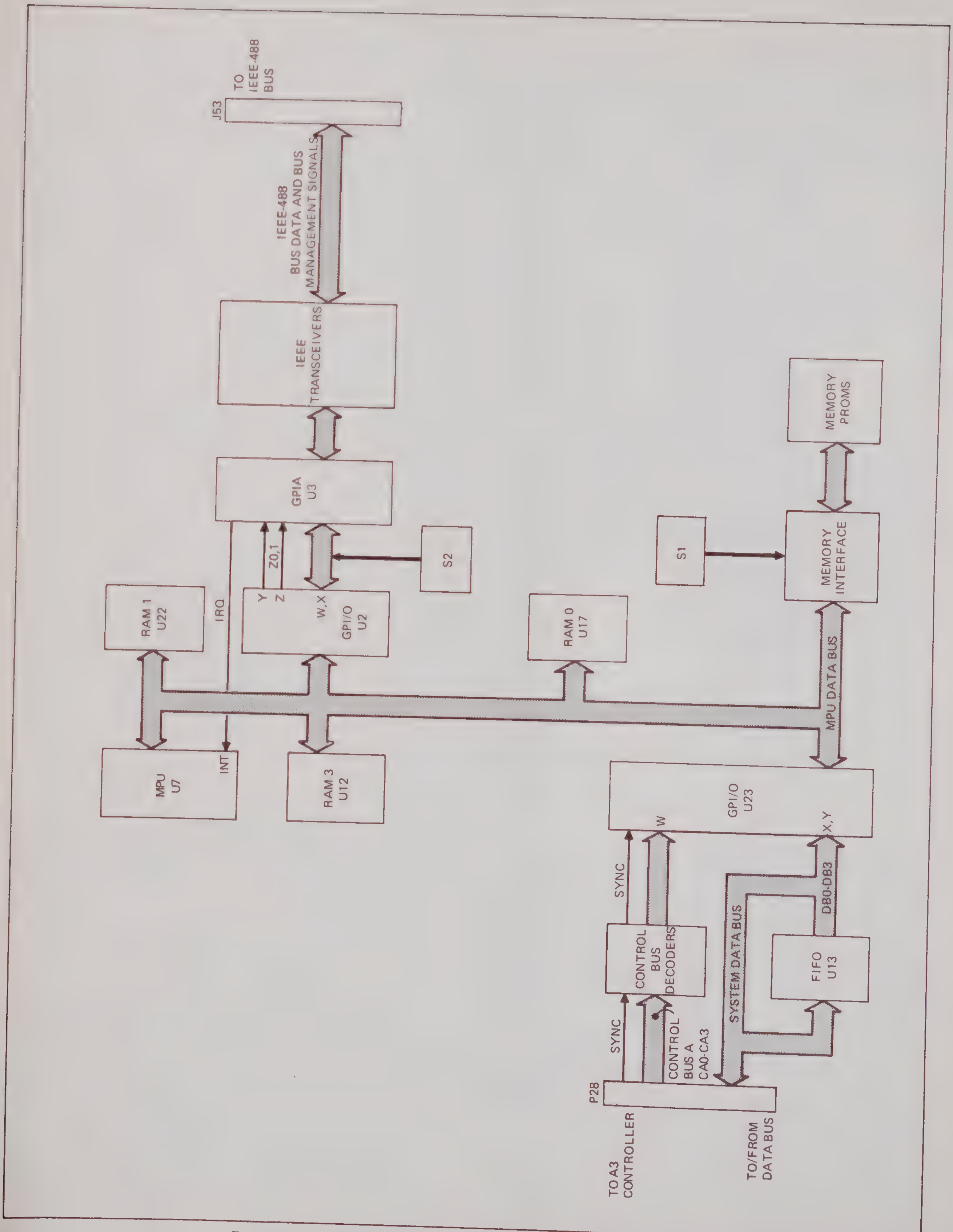

J53
TO IEEE-488 BUS
IEEE-488 BUS DATA AND BUS MANAGEMENT SIGNALS
IEEE TRANSCEIVERS
GPIA U3
Z0,1
S2
Y
Z
W,X
GPI/O U2
IRQ
RAM 1 U22
MPU U7
INT
RAM 3 U12
RAM 0 U17
MEMORY PROMS
MEMORY INTERFACE
S1
MPU DATA BUS
GPI/O U23
W
X,Y
SYNC
CONTROL BUS DECODERS
DB0-DB3
SYSTEM DATA BUS
FIFO U13
SYNC
CONTROL BUS A CA0-CA3
P28
TO A3 CONTROLLER
TO/FROM DATA BUS

Figure 637-3. IEEE Interface Functional Block Diagram

637-33. Operation of the IEEE Interface can be functionally divided into two sequences; Listen and Talk. The Listen function is restricted to thereception of a Group Execute Trigger from the bus controller. The reception of GET (with the REMOTE switch depressed) will initiate a single scan. The Talk function involves the transfer output data (scan and measurement data) from the data logger to the IEEE-488 Bus. For both cases, each I/O word (up to 18 characters) is temporarily stored on the IEEE-488 Interface to synchronize its transfer operations with either the A3 Controller or devices on the IEEE-488 Bus as required.

637-33. Listen Function

637-34. Bit-parallel, byte-serial program data from the IEEE-488 Bus is received by the pcb through IEEE-488 compatible transceivers to the GPIA (General Purpose Interface Adapter) U3. When a character byte is received, the GPIA drives Interrupt Request (IRQ) low (0.0V). (IRQ is connected to the Interrupt (INT) input on the MPU.) In response to an INT low input, the MPU reads the 8-bit data-in character byte from the GPIA via GPI/O (U2) and the MPU Data Bus. Data characters received by the MPU, are transferred and stored in RAM 0 (Random Access Memory). Input data is checked by the MPU to determine if a remote start command is present. Remote start command is indicated by the presence of the Group Execute Trigger (GET). When GET is received, the IEEE Interface sends the appropriate poll response to the A3 Controller.

637-35. To poll the IEEE Interface, the A3 Controller places a binary coded 6 onto Control Bus A (CA0-CA3). The pcb detects its code and responds with its current status via the System Data Bus. The possible response codes and their meanings are shown in Table 637-5.

Table 637-5. IEEE Interface Response Codes

BINARY CODED STATUS RESPONSE	DEFINITION
4	REMOTE START
5	REMOTE START
14	BUSY
15	NOT BUSY, NO INTERRUPT

637-36. Talk Function

637-37. When the A3 Controller is ready to put data onto the IEEE-488 Bus, it polls the status of the IEEE Interface by placing a binary coded 6 on Control Bus A. If the IEEE Interface is not busy it responds with a binary 15 via the System Data Bus and thereby prompts the controller to output data onto the IEEE-488 Bus. The controller places a binary coded 4 onto Control Bus A. This code is latched into port W of the GPI/O (U23) for later reference by the MPU. Subsequent data characters that appear on the System Data Bus are serially loaded into the FIFO (First-In First-Out) and held until accessed by the MPU. When accessed by the MPU, the 16 data characters are serially loaded into port X of the GPI/O (U23) by pulse Z1. All 16 characters are transferred and stored in RAM 0 for further processing. Processed data is transferred to RAM 1 and to await output to the IEEE-488 Bus. During the remainder of the sequence, the MPU checks the content and format of the received data. Before transfer to the IEEE-488 Bus occurs, the MPU polls the status of the GPIA and IEEE-488 Bus Control lines. If the IEEE Interface is addressed as a talker, NRFD (Not Ready For Data) is false (high) and the data out register of the GPIA is empty. The MPU also checks to see if SRQ is to be sent out. Data is then sent to the data out register of the GPIA for output on the IEEE-488 Bus.

637-38. Each character is transformed into an ASCII seven-level character by the MPU before being presented to the GPIA via ports W and X of the GPI/O (U3). Port Y is used to address the appropriate register in the GPIA. Each character is entered into the GPIA data out register by strobe Z0. The data is then sent to listeners on the IEEE-488 Bus via the handshake process.

637-39. MAINTENANCE

637-40. Access Information

637-41. Refer to the installation instructions given earlier in this subsection for IEEE Interface access information. Remove the rear panel output connector before attempting to remove the pcb from the data logger.

637-42. Performance Test

637-43. The IEEE Interface is most easily tested under normal operating conditions, i.e., installed in a functional data logger and interfaced with a IEEE-488 bus controller. Output data can then be checked by comparing data recorded on the internal printer with hard copy data derived from the external recording device.

637-44. LIST OF REPLACEABLE PARTS

637-45. The lists of replaceable parts for the -37 Option are given in Table 637-6. Refer to Section 5 of the data logger manual for ordering information.

Table 637-6. IEEE Interface PCB Assembly

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
	⊗IEEE INTERFACE PCB ASSEMBLY FIGURE 637-4 (2200B-4037T)	ORDER	BY	OPTION -37	1		
C1	CAP, TA, 10 UF, +/-20%, 20V	330662	56289	196D106X0020KA1	2		
C2	CAP, TA, 10 UF, +/-20%, 20V	330662	56289	196D106X0020KA1	REF		
C3	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	2		
C4	CAP, TA, 1 UF +/-20%, 35V	161919	56289	196D105X0020JA1	REF		
C5	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	11		
C6	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C7	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C8	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C9	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C10	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590.	CW30C224K	REF		
C11	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C12	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C13	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C14	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
C15	CAP, CER, 0.22 UF +/-20%, 50V	309849	71590	CW30C224K	REF		
CR1	DIODE, SI, HI-SPEED SWITCHING	203323	09214	1N4448	2		
CR2	DIODE, SI, HI-SPEED SWITCHING	203323	09214	1N4448	REF		
H1	HARDWARE KIT	429472	89536	429472	1		
H2	SCREW, PHP, 4-40 X 3/8	152124	89536	152124	3		
J53	CONNECTORS, IEEE	484220	89536	484220	1		
MP1	BRACKET	526624	89536	526624	1		
MP2	DECAL, P/N (NOT SHOWN)	546168	89536	546168	1		
Q1	XSTR, SI, PNP	195974	04713	2N3906	1	1	
Q2	XSTR, SI, NPN	218396	04713	2N3904	2	1	
Q3	XSTR, SI, NPN	218396	04713	2N3904	REF		
R1	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	5		
R2	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R3	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R4	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	5		
R5	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R6	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R7	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R8	RES, DEP. CAR, 6.2K +/-5%, 1/4W	442368	80031	CR251-4-5P6.2K	REF		
R9	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
R10	RES, DEP. CAR, 100K +/-5%, 1/4W	348920	80031	CR251-4-5P100K	1		
R11	RES, DEP. CAR, 30K +/-5%, 1/4W	368753	80031	CR251-4-5P30K	REF		
SW1	SWITCH, DIP	454769	89536	454769	2		
SW2	SWITCH, DIP	454769	89536	454769	REF		
TP1	CONNECTOR, TEST POINT	512889	89536	512889	7		
U1	⊗IC, C-MOS TRI-STATE HEX NON INVRTNG BUFF	407759	12040	MM80C97N	2	1	
U2	IC, PROGRAMABLE, GENERAL PURPOSE	453456	34649	P4265	2	1	
U3	⊗IC, C-MOS, N-CHANNEL, SILICON GATE	477794	04713	SC80910P/L	1	1	
U4	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	4	1	
U5	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		
U6	IC, 4-BIT MICROCOMPUTER	404434	34649	P4289CA	1	1	
U7	IC, 4-BIT MICROCOMPUTER	404418	34649	C4040	1	1	
U8	⊗IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	3	1	
U9	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		
U10	IC, QUAD, THREE-STATE BUS TRANSCEIVER	453480	04713	MC3448P	REF		

Table 637-6. IEEE Interface PCB Assembly (cont)

REF DES	DESCRIPTION	FLUKE STOCK NO.	MFG SPLY CODE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	NOTE
U11	IC, TESTED PROM SET	546044	89536	546044	1	1	
U12	IC, 4-BIT MICROCOMPUTER	404467	34649	P4002-2	1	1	
U13	⊗IC, C-MOS, FIFO REGISTER	495200	02735	CD40105BE	1	1	
U14	⊗IC, C-MOS, QUAD, 2-INPUT OR GATE	408393	02735	CD4071BE	1	1	
U15	⊗IC, C-MOS, DUAL, 4-INPUT, POS, NAND GATE	355206	04713	MC14012CP	2	1	
U16	⊗IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	REF		
U17	IC, 4-BIT MICROCOMPUTER	404442	34649	P4002-1	2	1	
U18	⊗IC, C-MOS TRI-STATE HEX NON INVRTNG BUFF	407759	12040	MM80C97N	REF		
U19	⊗IC, C-MOS, DUAL, 4-INPUT, POS, NAND GATE	355206	04713	MC14012CP	REF		
U20	⊗IC, C-MOS, HEX INVERTER, 14-PIN DIP	404681	02735	CD4069UBE	REF		
U21	IC, PART OF U11 TESTED SET	538835	89536	538835	REF		
U22	IC, 4-BIT MICROCOMPUTER	404442	34649	P4002-1	REF		
U23	IC, PROGRAMABLE, GENERAL PURPOSE	453456	34649	P4265	REF		
U24	⊗IC, C-MOS, QUAD 2-INPUT AND GATE	408401	02735	CD4081BE	1	1	
XU2	SOCKET, 28-PIN	448217	89536	448217	2		
XU3	SOCKET, 40-PIN	418988	89536	418988	2		
XU6	SOCKET, 40-PIN	418988	89536	418988	REF		
XU7	SOCKET, 24-PIN	418970	89536	418970	3		
XU11	SOCKET, 24-PIN	418970	89536	418970	REF		
XU12	SOCKET, 16-PIN	276535	89536	276535	3		
XU17	SOCKET, 16-PIN	276535	89536	276535	REF		
XU21	SOCKET, 24-PIN	418970	89536	418970	REF		
XU22	SOCKET, 16-PIN	276535	89536	276535	REF		
XU23	SOCKET, 28-PIN	448217	89536	448217	REF		
Z1	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	3	1	
Z2	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
Z3	RES, NETWORK, 100K +/-2%, 1/8W	461038	89536	461038	REF		
KIT	RECOMMENDED SPARE PARTS KIT	539817	89536	539817	AR		

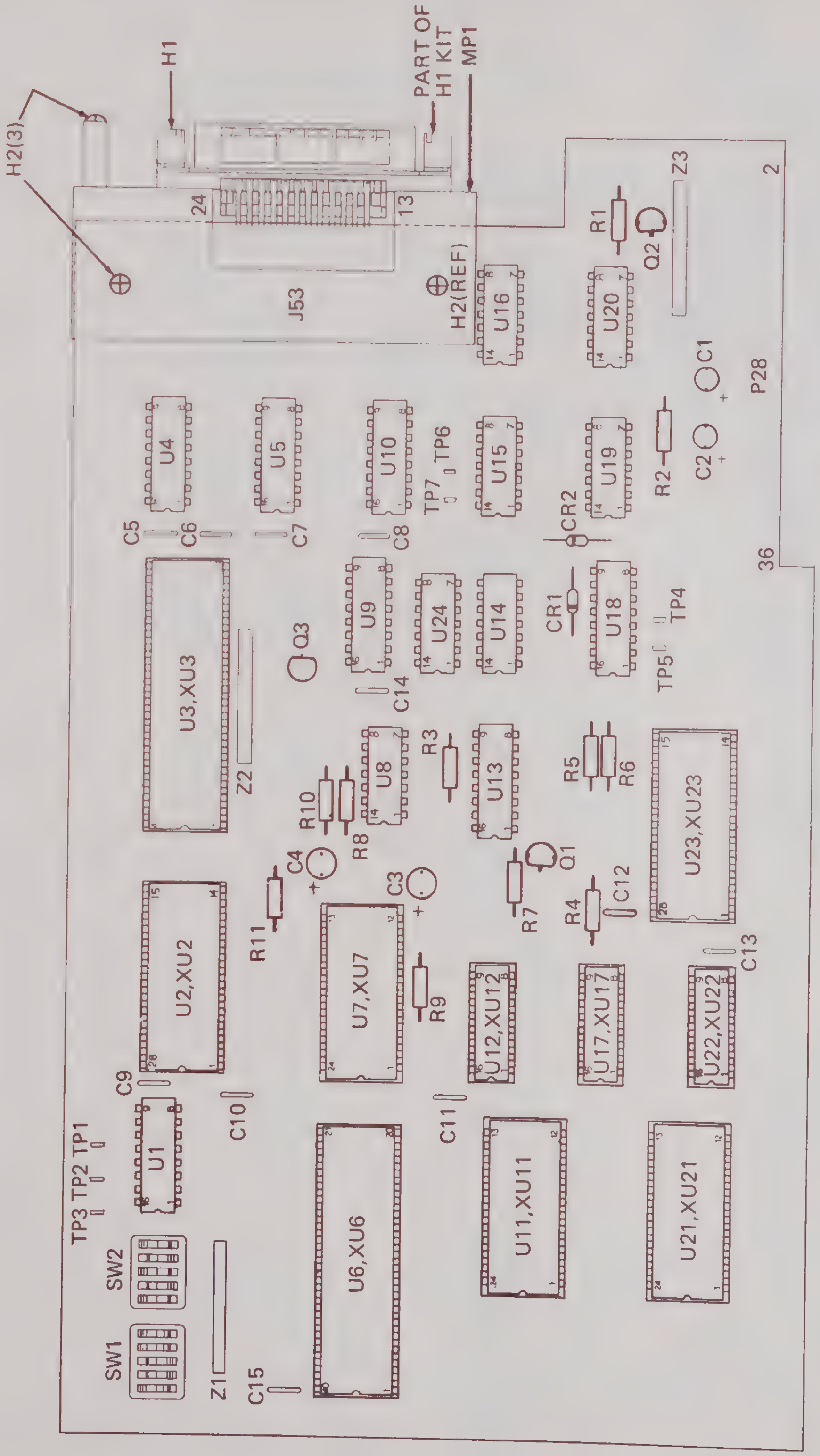

H2(3)
H1
PART OF H1 KIT
MP1
24
13
J53
H2(REF)
Z3
2
R1
Q2
U16
U20
C1
P28
U4
U5
U10
TP6
TP7
U15
U19
R2
C2
C5
C6
C7
C8
CR2
36
U3,XU3
Z2
Q3
U9
U24
U14
CR1
U18
TP4
TP5
C14
U8
R3
U13
R5
R6
U23,XU23
R10
R8
C4
C3
Q1
C12
R7
R4
U2,XU2
R11
U7,XU7
R9
U12,XU12
U17,XU17
U22,XU22
C13
C9
C10
C11
TP3 TP2 TP1
U1
U11,XU11
U21,XU21
SW2
SW1
Z1
C15
U6,XU6
2200B-1637

Figure 637-4. IEEE Interface PCB Assembly

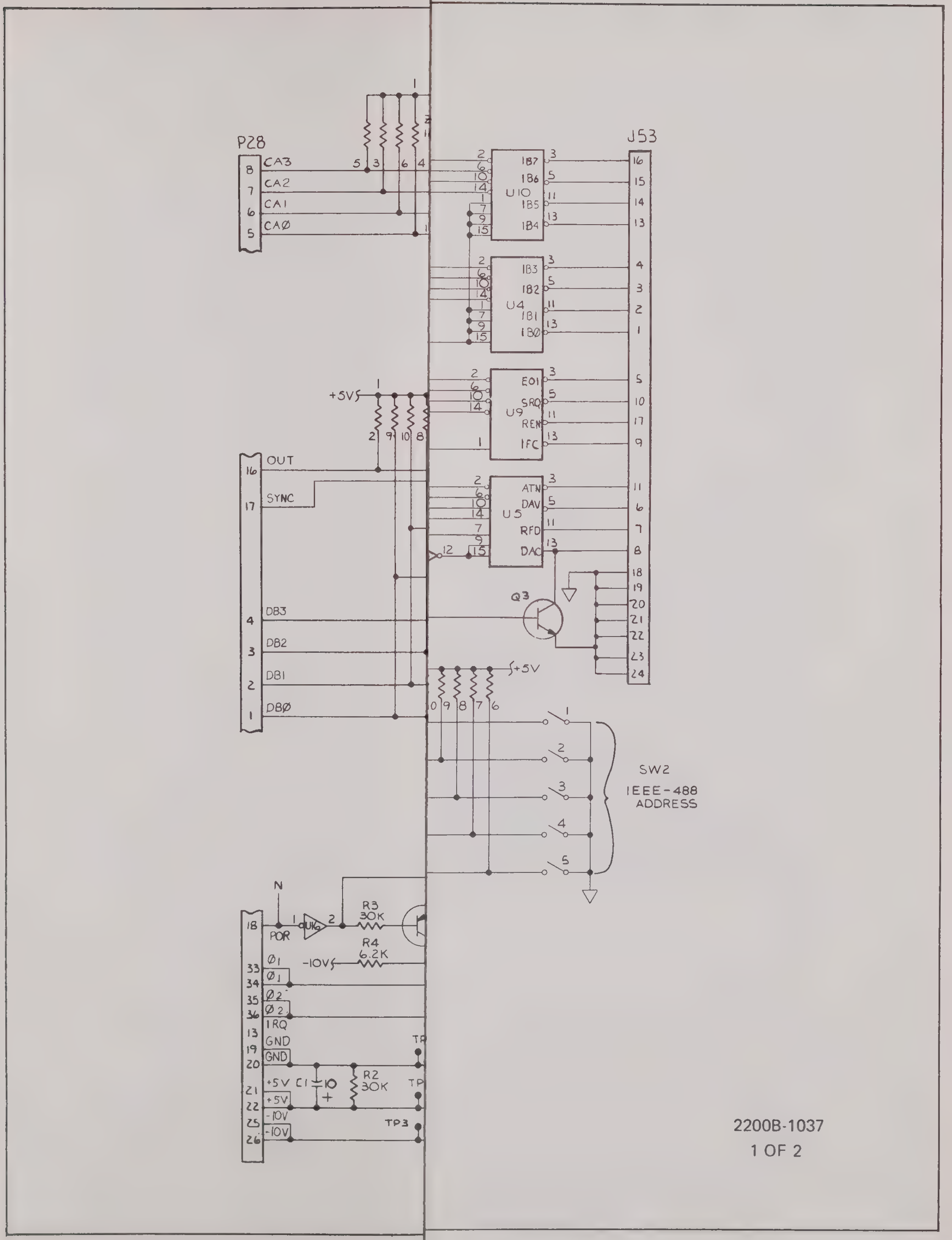

P28
CA3
CA2
CA1
CAØ
J53
U10
1B7
1B6
1B5
1B4
U4
1B3
1B2
1B1
1BØ
U9
EOI
SRQ
REN
IFC
U5
ATN
DAV
RFD
DAC
+5V
OUT
SYNC
DB3
DB2
DB1
DBØ
Q3
+5V
SW2
IEEE-488
ADDRESS
N
POR
U16
R3
30K
R4
6.2K
-10V
Ø1
Ø2
IRQ
GND
+5V
-10V
C1
10
R2
30K
TP3
2200B-1037
1 OF 2

Figure 637-4. IEEE Interface PCB Assembly (cont)

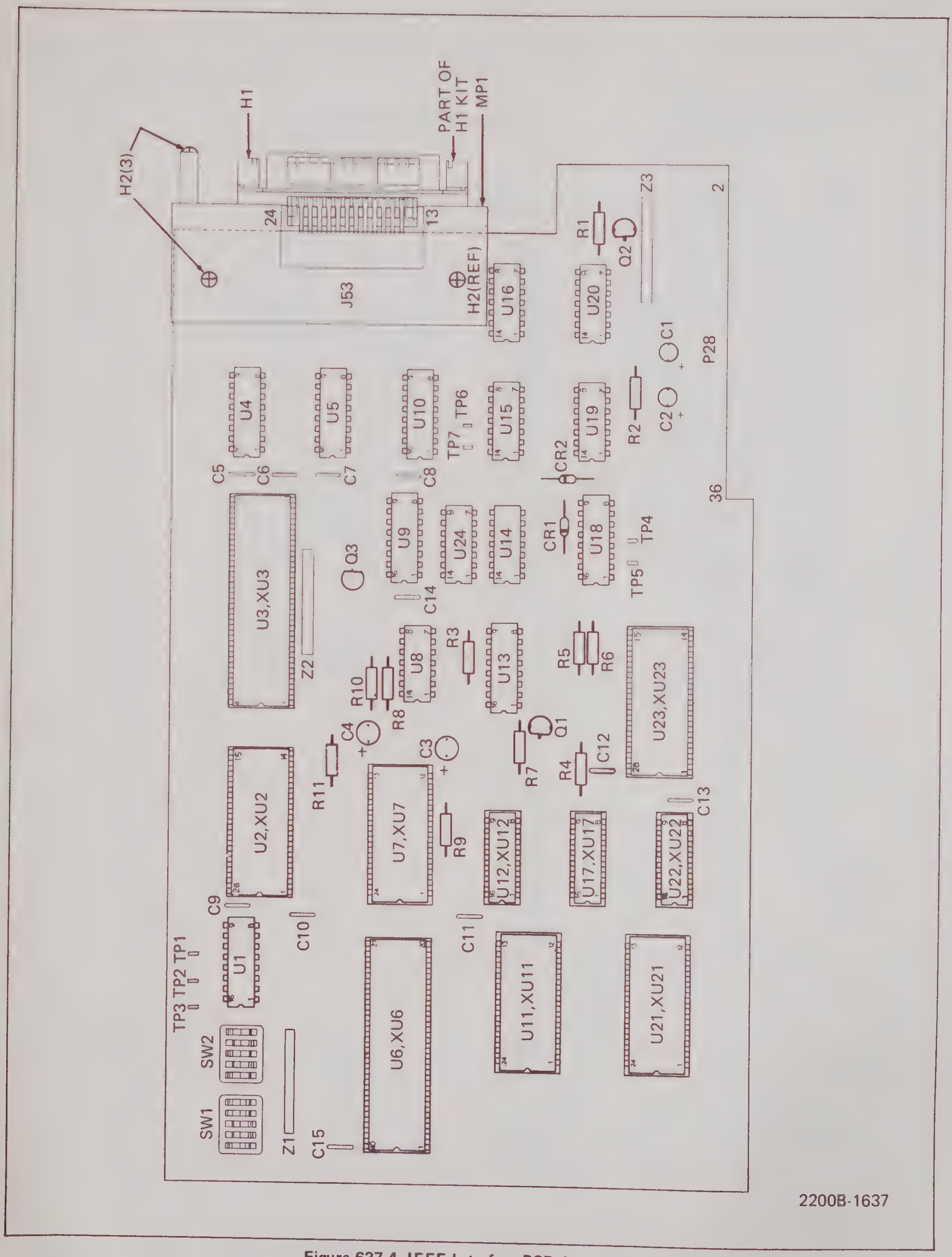
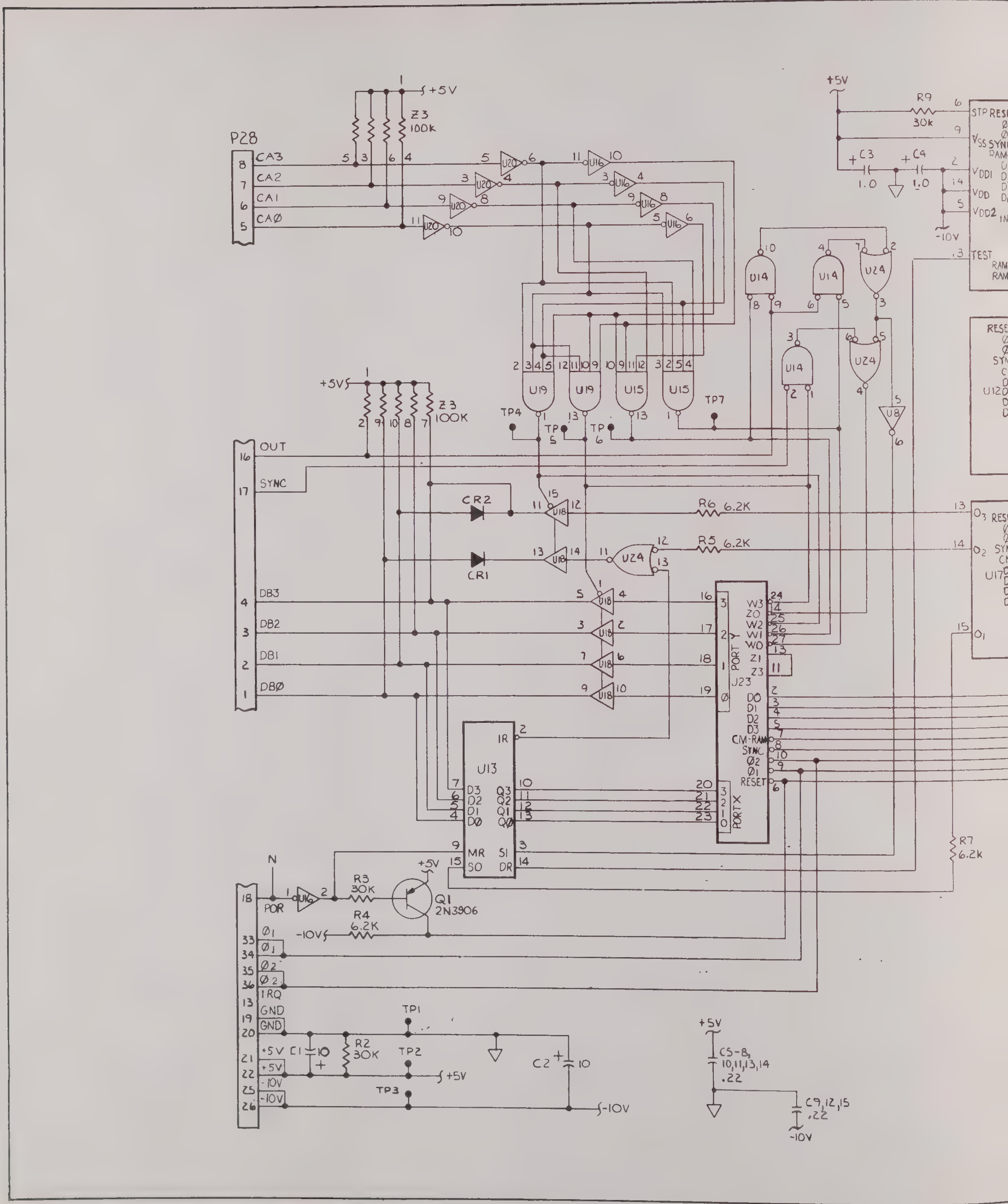

H2(3)
H1
PART OF H1 KIT
MP1
24
13
J53
H2(REF)
Z3
2
R1
Q2
U16
U20
C1
P28
U4
U5
U10
TP7
TP6
U15
U19
R2
C2
C5
C6
C7
C8
CR2
36
U3,XU3
Q3
U9
U24
U14
CR1
U18
TP4
TP5
C14
Z2
R10
R8
U8
R3
U13
R5
R6
U23,XU23
C4
C3
Q1
R7
R4
C12
R11
U2,XU2
U7,XU7
R9
U12,XU12
U17,XU17
U22,XU22
C13
C9
C10
C11
TP3 TP2 TP1
U1
SW2
SW1
Z1
C15
U6,XU6
U11,XU11
U21,XU21
2200B-1637

Figure 637-4. IEEE Interface PCB Assembly


P28
CA3
CA2
CA1
CA0
Z3
100K
+5V
U20
U16
U19
U15
U14
U24
U8
TP4
TP5
TP6
TP7
OUT
SYNC
DB3
DB2
DB1
DB0
CR1
CR2
U18
R6 6.2K
R5 6.2K
U13
IR
D3
D2
D1
D0
Q3
Q2
Q1
Q0
MR
SO
SI
DR
PORT Y
PORT X
J23
W3
Z0
W2
W1
W0
Z1
Z3
D0
D1
D2
D3
CM-RAM
SYNC
Ø2
Ø1
RESET
N
POR
Ø1
Ø2
IRQ
GND
+5V
-10V
R3 30K
R4 6.2K
Q1 2N3906
TP1
TP2
TP3
C1 10
R2 30K
C2 10
CS-8, 10,11,13,14 .22
C9,12,15 .22
R9 30k
C3 1.0
C4 1.0
STP
VSS
VDD1
VDD
VDD2
TEST
-10V
R7 6.2K
U12
U17

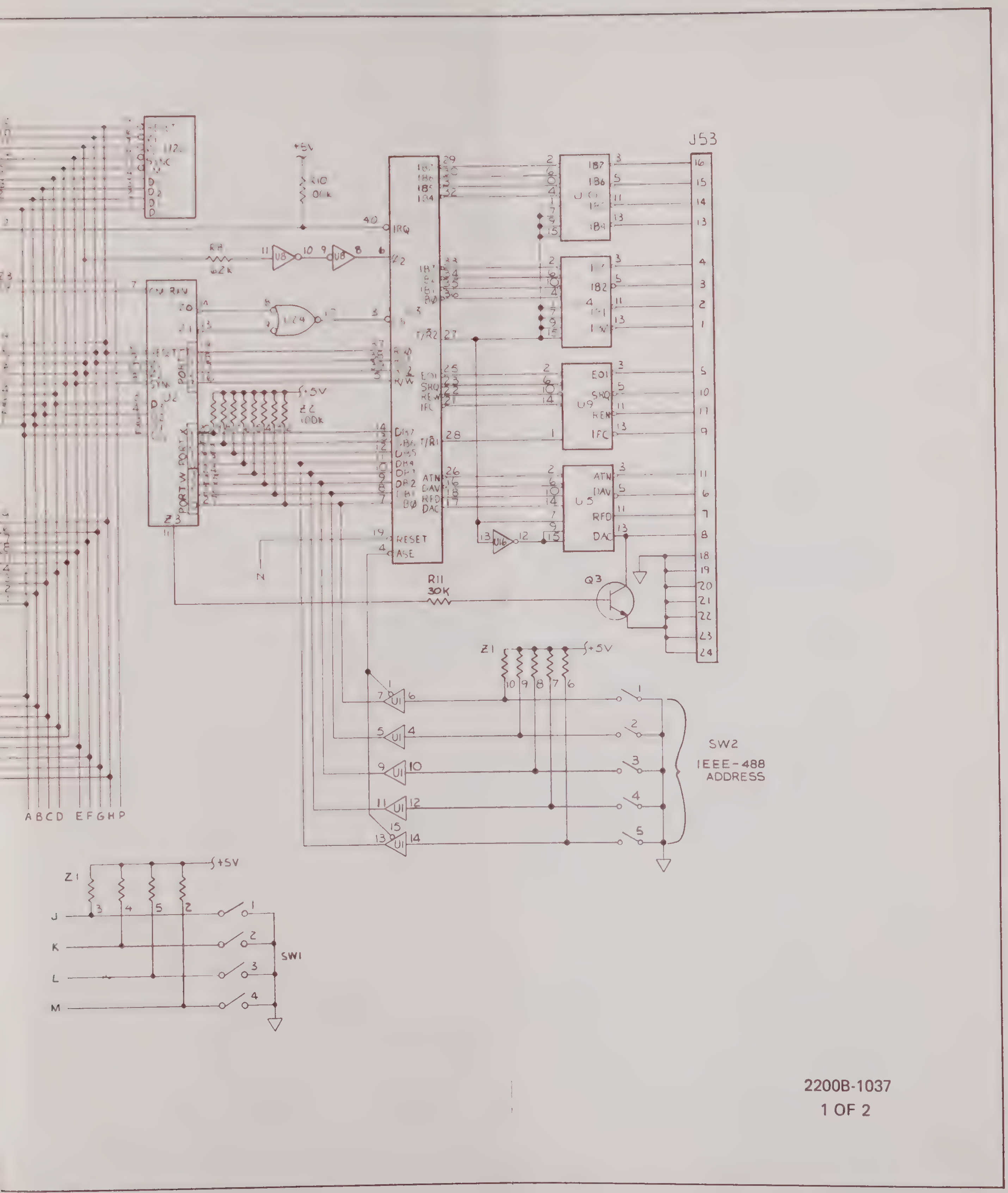

J53
+5V
R10
10K
IRQ
R8
62K
U8
U24
T/R2
R/W
EOI
SRQ
REN
IFC
DI07
T/R1
ATN
DAV
RFD
DAC
RESET
ASE
PORT W
PORT X
Z2
100K
Z3
IB7
IB6
IB5
IB4
IB2
U6
U9
U5
U16
Q3
R11
30K
Z1
+5V
U1
SW2
IEEE-488
ADDRESS
A B C D E F G H P
J
K
L
M
SW1
2200B-1037
1 OF 2

Figure 637-4. IEEE Interface PCB Assembly (cont)

Section 7

General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable Parts contained in Section 5.

List of Abbreviations and Symbols

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
°C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
°F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^9)
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^3)
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^6)
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(−) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmablle read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

Federal Supply Codes for Manufacturers

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisburg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884
Use 56289
Sprague Electric Co
Dearborn Electronic Div
Lockwood, Florida

02114
Ferroxcube Corp
Saugerties, New York

02131
General Instrument Corp
Harris ASW Div
Westwood, Maine

02395
Rason Mfg. Co
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp
Whippany, New Jersey

03911
Clairex Electronics Div
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc
Wire & Cable Div
Anaheim California

04221
Aemco, Div of
Midtex Inc
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571
Use 56289
Sprague Electric Co
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
The Ross Milton Co.
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Div.
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, Massachusetts

07261
Aumet Corp
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933
Use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

Federal Supply Codes for Manufacturers (cont)

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988
Use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co Semi-Conductor
Products Dept
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, Minnesota

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp.
Rectifier Division
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Div.
AMF Canada LTD.
Guelph, Ontario, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
The Budd Co. Polychem Products
Plastic Products Div.
Bridgeport, Pennsylvania

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606
Use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors,
formerly Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics
Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
GTE Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

Federal Supply Codes for Manufacturers (cont)

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Bucheye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30323
Illinois Tool Works, Inc.
Chicago, Illinois

31091
Optimax Inc.
Colmar, Pennsylvania

32539
Mura Corp.
Great Neck, New York

32767
Griffith Plastic Corp.
Burlingame, California

32879
Advanced Mechanical
Components
Northridge, California

32897
Erie Technological Products, Inc.
Frequency Control Div.
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Products Division
Riverside, California

33173
General Electric Co.
Products Dept.
Owensboro, Kentucky

34333
Silicon General
Westminister, California

34335
Advanced Micro Devices
Sunnyvale, California

34802
Electromotive Inc.
Kenilworth, New Jersey

37942
P.R. Mallory & Co., Inc.
Indianapolis, Indiana

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.
Transformer Co. Div.
Geneva, New York

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Lexington, Massachusetts

50088
Mostek Corp.
Carrollton, Texas

50579
Litronix Inc.
Cupertino, California

51605
Scientific Components Inc.
Linden, New Jersey

53021
Sangamo Electric Co.
Springfield, Illinois

54294
Cutler-Hammer Inc. formerly
Shallcross, A Cutter-Hammer Co.
Selma, North Carolina

55026
Simpson Electric Co.
Div. of Am. Gage and Mach. Co.
Elgin, Illinois

56289
Sprague Electric Co.
North Adams, Massachusetts

58474
Superior Electric Co.
Bristol, Connecticut

60399
Torin Corp. formerly
Torrington Mfg. Co.
Torrington, Connecticut

63743
Ward Leonard Electric Co., Inc.
Mount Vernon, New York

64834
West Mfg. Co.
San Francisco, California

65092
Weston Instruments Inc.
Newark, New Jersey

66150
Winslow Tele-Tronics Inc.
Eaton Town, New Jersey
70485
Atlantic India Rubber Works
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnback Radio Co., Inc.
Freeport, New York

71400
Bussmann Mfg.
Div. of McGraw-Edison Co.
Saint Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Electric Inc.
Santa Ana, California

71482
Clare, C.P. & Co.
Chicago, Illinois

71590
Centrelab Electronics
Div. of Globe Union Inc.
Milwaukee, Wisconsin

71707
Coto Coil Co., Inc.
Providence, Rhode Island

71744
Chicago Miniature Lamp Works
Chicago, Illinois

71785
TRW Electronics Components
Cinch Connector Operations Div.
Elk Grove Village
Chicago, Illinois

72005
Wilber B. Driver Co.
Newark, New Jersey

72092
Replaced by 06980

72136
Electro Motive Mfg. Co.
Williamantic, Connecticut

72259
Nytronics Inc.
Pelham Manor, New Jersey

72619
Dialight Div.
Amperex Electronic Corp.
Brooklyn, New York

72653
G.C. Electronics
Div. of Hydrometals, Inc.
Brooklyn, New York

72665
Replaced by 90303
72794
Dzus Fastener Co., Inc.
West Islip, New York

72928
Gulton Ind. Inc.
Gudeman Div.
Chicago, Illinois

Federal Supply Codes for Manufacturers (cont)

72982
Erie Tech. Products Inc.
Erie, Pennsylvania

73138
Bechman Instrument Inc.
Helipot Division
Fullerton, California

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp
Hicksville, New York

73559
Carling Electric Inc
West Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products, Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cincinnati, Ohio

73899
JFD Electronics Co.
Components Corp.
Brooklyn, New York

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quan Nichols Co.
Chicago, Illinois

74217
Radio Switch Corp.
Marlboro, New Jersey

74276
Signalite Div.
General Instrument Corp.
Neptune, New Jersey

74306
Piezo Crystal Co.
Carlisle, Pennsylvania

74542
Hoyt Elect. Instr. Works
Penacook, New Hampshire

74970
Johnson E.F., Co.
Waseca, Minnesota

75042
TRW Electronics Components
IRC Fixed Resistors
Philadelphia, Pennsylvania

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
Mount Vernon, New York

75915
Littlefuse Inc.
Des Plaines, Illinois

76854
Oak Industries Inc.
Switch Div.
Crystal Lake, Illinois

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77638
General Instrument Corp.
Rectifier Division
Brooklyn, New York

77969
Rubbercraft Corp. of CA. LTD.
Torrance, California

78189
Shakeproof
Div. of Illinois Tool Works Inc.
Elgin, Illinois

78277
Sigma Instruments, Inc.
South Braintree, Massachusetts

78488
Stackpole Carbon Co.
Saint Marys, Pennsylvania

78553
Eaton Corp. Engineered
Fastener Div.
Tinnerman Plant
Cleveland, Ohio

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Company
Goshen, Indiana

79963
Zierick Mfg. Corp.
Mt. Kisko, New York

80031
Electro-Midland Corp.
Mepco Div.
A North American Phillips Co.
Norristown, New Jersey

80145
LFE Corp., Process Control Div.
formerly API Instrument Co.
Chesterland, Ohio

80183
Use 56289
Sprague Products
North Adams, Massachusetts

80294
Bourns Inc., Instrument Div.
Riverside, California

80583
Hammarlund Mfg. Co., Inc.
Red Bank, New Jersey

80640
Arnold Stevens, Inc.
South Boston, Massachusetts

81073
Grayhill, Inc.
La Grange, Illinois

81312
Winchester Electronics
Div. of Litton Industries Inc.
Oakville, Connecticut

81483
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp
Los Angeles, California

81590
Korry Mfg. Co.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Chicago, Illinois

82415
North American Phillips
Controls Corp.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Woodstock, New York

82879
ITT Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83058
The Carr Co., United Can Div.
of TRW
Cambridge, Massachusetts

83298
Bendix Corp.
Electric Power Div.
Eatontown, New Jersey

83330
Herman H. Smith, Inc.
Brooklyn, New York

83478
Rubbercraft Corp.
of America, Inc.
West Haven, Connecticut

83594
Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740
Union Carbide Corp.
Battery Products Div.
formerly Consumer Products Div
New York, New York

84171
Arco Electronics
Great Neck, New York

84411
TRW Electronic Components
TRW Capacitors
Ogallala, Nebraska

84613
Fuse Indicator Corp.
Rockville, Maryland

84682
Essex International Inc.
Industrial Wire Div.
Peabody, Massachusetts

86577
Precision Metal Products
of Malden Inc.
Stoneham, Massachusetts

86684
Radio Corp. of America
Electronic Components Div.
Harrison, New Jersey

86928
Seastrom Mfg. Co., Inc.
Glendale, California

87034
Illuminated Products Inc.
Subsidiary of Oak Industries Inc.
Anahiem, California

88219
Gould Inc.
Industrial Div.
Trenton, New Jersey

88245
Litton Systems Inc.
Useco Div.
Van Nuys, California

88419
Cornell-Dubilier Electronic Div.
Federal Pacific Co.
Fuquay-Varian, North Carolina

88486
Plastic Wire & Cable
Jewitt City, Connecticut

88690
Replaced by 04217

89536
John Fluke Mfg. Co., Inc.
Seattle, Washington

89730
G.E. Co., Newark Lamp Works
Newark, New Jersey

Federal Supply Codes for Manufacturers (cont)

90201
Mallory Capacitor Co.
Div. of P.R. Mallory Co., Inc.
Indianapolis, Indiana

90211
Use 56365
Square D Co.
Chicago, Illinois

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Mallory Battery Co.
Div. of Mallory Co., Inc.
Tarrytown, New York

91094
Essex International Inc.
Suglex/IWP Div.
Newmarket, New Hampshire

91293
Johanson Mfg. Co.
Boonton, New Jersey

91407
Replaced by 58474

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
Willow Grove, Pennsylvania

91737
Use 71468
Gremar Mfg. Co., Inc.
ITT Cannon/Gremar
Santa Ana, California

91802
Industrial Devices, Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co., Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co., Inc.
Div. of Aunet
Woonsocket, Rhode Island

92194
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154
Use 94988
Wagner Electric Corp.
Tung-Sol Div.
Newark, New Jersey

94222
Southco Inc. formerly
South Chester Corp.
Lester, Pennsylvania

95146
Alco Electronic Products Inc.
Lawrence, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95264
Replaced by 98278

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95712
Bendix Corp.
Electrical Components Div.
Microwave Devices Plant
Franklin, Indiana

95987
Weckesser Co. Inc.
Chicago, Illinois

96733
San Fernando Electric Mfg. Co.
San Fernando, California

96853
Gulton Industries Inc.
Measurement and Controls Div.
formerly Rustrak Instruments Co.
Manchester, New Hampshire

96881
Thomson Industries, Inc.
Manhasset, New York

97540
Master Mobile Mounts, Div. of
Whitehall Electronics Corp.
Ft. Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Penwalt Corp.
SS White Industrial Products Div.
Piscataway, New Jersey

97966
Replaced by 11358

98094
Replaced by 49956

98159
Rubber-Teck, Inc.
Gardena, California

98278
Malco A Microdot Co., Inc.
Connector & Cable Div.
Pasadena, California

98291
Sealectro Corp.
Mamaroneck, New York

98388
Royal Industries
Products Div.
San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

99120
Plastic Capacitors, Inc.
Chicago, Illinois

99217
Bell Industries Elect.
Comp. Div.
formerly Southern Elect. Div.
Burbank, California

99392
STM
Oakland, California

99515
ITT Jennings Monrovia Plant
Div. of ITT Jennings formerly
Marshall Industries Capacitor Div.
Monrovia, California

99779
Use 29587
Bunker-Ramo Corp.
Barnes Div.
Landsdowne, Pennsylvania

99800
American Precision Industries Inc.
Delevan Division
East Aurora, New York

99942
Centrelab Semiconductor
Centrelab Electronics Div. of
Globe-Union Inc.
El Monte, California

Toyo Electronics
(R-Ohm Corp.)
Irvine, California

National Connector
Minneapolis, Minnesota

U.S. SALES AREAS for all Fluke products

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Harry Lang & Associates
1371 Hillcrest Drive #303
Anchorage, AK 99503
(907) 279-5741

AL, Huntsville
John Fluke Mfg. Co., Inc.
3322 S. Memorial Parkway
Suite 96
Huntsville, AL 35801
(205) 881-6220

AZ, Tempe
John Fluke Mfg. Co., Inc.
2125 S. 48th Street
Suite 104
Tempe, AZ 85282
(602) 967-8724
Tucson
(602) 790-9881

CA, Los Angeles
John Fluke Mfg. Co., Inc.
20902 South Bonita St.
Carson, CA 90746
(213) 538-3900
or (714) 761-2449

Santa Clara
John Fluke Mfg. Co., Inc.
2300 Walsh Ave., Bldg. K
Santa Clara, CA 95051
(408) 727-0513

San Diego
John Fluke Mfg. Co., Inc.
9601 Aero Drive, Suite 290
San Diego, CA 92123
(714) 226-1254

Tustin
John Fluke Mfg. Co., Inc.
15445 Red Hill Ave., Suite F
Tustin, CA 92680
(714) 838-8863

CO, Denver
John Fluke Mfg. Co., Inc.
1980 South Quebec St. #4
Denver, CO 80231
(303) 750-1222

CT, Hartford
John Fluke Mfg. Co., Inc.
124 Hebron Ave.
Glastonbury, CT 06033
(203) 633-0777

FL, Orlando
John Fluke Mfg. Co.,Inc.
940 N. Fern Creek Ave.
Orlando, FL 32803
(305) 896-4881

GA, Atlanta
2700 Delk Rd., Suite 250
Marietta, GA 30067
(404) 953-4747

HI, Honolulu
EMC Corporation
2979 Ualena St.
Honolulu, HI 96819
(808) 836-1138

IA, Iowa City
(319) 354-2811

IL, Chicago
John Fluke Mfg. Co., Inc.
3740 Industrial Ave.
Rolling Meadows, IL 60008
(312) 398-0850

IN, Indianapolis
John Fluke Mfg. Co., Inc.
5610 Crawfordsville Rd.
Suite 802
Indianapolis, IN 46224
(317) 244-2456

KS, Kansas City
John Fluke Mfg. Co., Inc.
4550 W. 109th St., Suite 130
Shawnee Mission, KA 66211
(913) 381-9800

LA, New Orleans
(504) 455-0814

MA, Burlington
John Fluke Mfg. Co., Inc.
25 "B" Street
Burlington MA 01803
(617) 273-4674

MD, Baltimore
(301) 792-7060

Rockville
John Fluke Mfg. Co., Inc.
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

MI, Detroit
John Fluke Mfg. Co., Inc.
13955 Farmington Rd.
Livonia, MI 48154
(313) 522-9140

MN, Minneapolis
John Fluke Mfg. Co., Inc.
7373 W. 147th St., Suite 196
Apple Valley, MN 55124
(612) 432-9400

MO, St. Louis
John Fluke Mfg. Co., Inc.
300 Brookes Dr., Suite 100
Hazelwood, MO 63042
(314) 731-3388

NC, Greensboro
John Fluke Mfg. Co., Inc.
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

NJ, Paramus
John Fluke Mfg. Co., Inc.
P.O. Box 930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

NM, Albuquerque
John Fluke Mfg. Co., Inc.
1108 Alvarado Drive N.E.
Albuquerque, NM 87110
(505) 265-8431

NY, Rochester
John Fluke Mfg. Co., Inc.
4515 Culver Road
Rochester, NY 14622
(716) 266-1400

OH, Cleveland
John Fluke Mfg. Co., Inc.
7830 Freeway Circle
Middleburg Heights, OH 44130
(216) 234-4540

Columbus
(614) 889-5715

Dayton
John Fluke Mfg. Co., Inc.
4756 Fishburg Rd.
Dayton, OH 45424
(513) 233-2238

OR, Portland
John Fluke Mfg. Co., Inc.
18360 S.W. Springfield Lane
Aloha, OR 97007
(503) 642-1342

PA, Philadelphia
John Fluke Mfg. Co., Inc.
1010 West 8th Ave., Suite H
King of Prussia, PA 19406
(215) 265-4040

Pittsburgh
(412) 261-5171

TX, Austin
John Fluke Mfg. Co., Inc.
Creek Gardens, Suite 103
8705 Shoal Creek Blvd.
Austin, TX 78758
(512) 459-3344

Dallas
John Fluke Mfg. Co., Inc.
14400 Midway Road
Dallas, TX 75234
(214) 233-9990

Houston
John Fluke Mfg. Co., Inc.
4240 Blue Bonnet Dr.
Stafford, TX 77477
(713) 491-5995

San Antonio
10417 Gulfdale
San Antonio, TX 78216
(512) 340-2621

UT, Salt Lake City
John Fluke Mfg. Co., Inc.
5226 So. 300 West, Suite #2
Salt Lake City, UT 84107
(801) 268-9331

WA, Seattle
John Fluke Mfg. Co., Inc.
975 Industry Drive
Seattle, WA 98188
(206) 575-3765

Service Center Areas

CA, Burbank (213) 849-4641
CA, Santa Clara (408) 727-8121
CO, Denver (303) 750-1228
FL, Orlando (305) 896-2296
IL, Chicago (312) 398-5800
MA, Burlington (617) 273-4678
MD, Rockville (301) 770-1576
NJ, Paramus (201) 262-9550
TX, Dallas (214) 233-9945
WA, Everett (206) 356-5560

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are stocked locally and sold by the Authorized Distributors listed on the back of this folder, as well as by the sales offices shown.

Handheld DMM's: 8020A, 8021B, 8022B, 8024B, 8060A, 8062A
Portable DMM's: 8000A, 8010A, 8012A, 8030A, 8040A, 8050A
Digital Counters: 1900A, 1910A, 1911A, 1912A
Digital Thermometers: 2160 - and 2170 - Series

All other instruments are sold by the sales offices only.

For more information on Fluke products or Sales Offices you may dial (800) 426-0361 toll-free in most of U.S. From Alaska, Hawaii, or Washington, phone (206) 356-5400. From Canada and other countries phone (206) 356-5500.

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John Fluke Mfg. Co., Inc. P.O. Box C9090, Everett, WA 98206
Fluke (Holland) B.V., P.O. Box 5053, 5004 EB, Tilburg, The Netherlands, Phone (013) 673973
Litho in. U.S.A. 8/82

INTERNATIONAL SALES OFFICES

Argentina ●
Coasin, S.A
Virrey del Pino 4071
Buenos Aires, Argentina
Tel 552-5248, TLX. 122284

Australia ●
Elmeasco Instruments Pty Ltd
P.O Box 30, Concord, N S W
Australia 2137
Tel (2) 736-2888, TLX 25887

Elmeasco Instruments Pty Ltd
21-23 Anthony Drive
Mt Waverly, VIC 3149
Australia
Tel 233-4044, TLX 36206

Elmeasco Instruments Pty Ltd
Professional Suites Bldg
G P O Box 2360
Brisbane, 4001, Australia
Tel (07) 229-3161

Elmeasco Instruments Pty Ltd
G P O Box 1240, Adelaide
South Australia 5001
Tel (08) 271-1839

Elmeasco Instruments Pty Ltd
P O Box 95, Gosnells
West Australia 6110
Tel (09) 398-3362

Austria ■
Walter Rekirsch
Elektronische Gerate GmbH & Co
Liechtensteinstrasse 97/6
Vienna, Austria
Tel (0222) 235555, TLX: 134759

Bangladesh ●
Motherland Corporation
24 Hatkhola Rd., Tikatuli
Dacca 3, Bangladesh
Tel 257249

Belgium ■
Fluke (Belgium) S.A./N.V
6, Rue de Geneve
1140 Brussels, Belgium
Tel: (2) 2164090, TLX: 26312

Bolivia ●
Coasin Bolivia S.R.L.
Casilla 7295, La Paz, Bolivia
Tel 40962, TLX: 5255

Brazil ●
Fluke Brasil-Industria E
Commercio LTDA
Al. Amazonas 422,
Alphaville, Barueri,
CEP 06400 Sao Paulo, Brazil
Tel: (011) 421-3603, TLX: 01135589

Fluke Brasil-Industria E
Commercio LTDA
Av. Henrique Valadares, 23/401
Rio de Janeiro, Brazil
Tel: 252-1297

Brunei ●
Rank O'Connor's (PTE) Limited
No. 8, BK.D
Surfri Shop House Complex
Mile 1, Jalong Tutong
Bandar Seri Begawan, Brunei
Tel: 26680

Bulgaria ■
Amtest Associates Ltd.
Clarence House, 31, Clarence St.
Staines, Middlesex TW18 45Y
United Kingdom
Tel: (784) 63555, TLX: 928855

Canada ●
Allan Crawford Assoc., Ltd.
#14 1935 30th Ave. N.E
Calgary, Alberta T2E 6Z5
Tel: (403) 230-1341, TLX. 03-821186

Allan Crawford Assoc., Ltd.
P.O. Bag 3967
Postal Station "D"
Edmonton, Alberta T5L 4K1
Tel. (403) 451-4893

Allan Crawford Assoc., Ltd.
3795 William Street
Burnaby, British Columbia V5C 3H3
Tel (604) 294-1326, TLX: 04-54247

Allan Crawford Assoc., Ltd
192 Joseph Zatzman Dr.
Suite 4
Burnside Industrial Park
Dartmouth, Nova Scotia B3B 1N4
Tel (902) 463-8640, TLX: 01931604

Allan Crawford Assoc , Ltd
881 Lady Ellen Place
Ottawa, Ontario K1Z 5L3
Tel. (613) 722-7682, TLX. 0533600

Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ontario L4V 1J2
Tel: (416) 678-1500, TLX: 06968769

Allan Crawford Assoc., Ltd.
7918 cote de Liesse
St Laurent, Quebec H4T 1E7
Tel: (514) 731-8564, TLX: 05824944

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Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB Tilburg
Zevenheuvelenweg 53, 5048 AN Tilburg
The Netherlands
Tel: (013) 673973, TLX: 52237

Chile ●
Intronica Chile Ltda
Manuel Montt 024 - Of. D
Casilla 16228, Santiago 9, Chile
Tel: 44940, TLX: 340260 Cab. Publ.,
Attn. Intronica Chile

China, People's Republic of ●
Fluke International Corporation
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Everett, WA 98206, U.S.A.
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TLX: 152662 JOHN FLUKE EVT

Colombia ●
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aereo 29583
Bogota DE, Colombia SA
Tel: 232-45-32, TLX: 45787

Cyprus ■
Chris Radiovision Ltd.
P.O. Box 1989, Nicosia, Cyprus
Tel: 66121, TLX: 8262395

Czechoslovakia ■
Amtest Associates Ltd.
Clarence House, 31, Clarence St.
Staines, Middlesex TW18 45Y
United Kingdom
Tel: (784) 63555, TLX: 928855

Denmark ■
Tage Olsen A/S
Ballerup Byvej 222
DK - 2750 Ballerup, Denmark
Tel: (2) 658111, TLX: 35293

Ecuador ●
Proteco Coasin Cia., Ltda
Edificio "Jerico"
Ave. 12 de octubre #2285 y
Ave. Orellana (Planta Baja)
Quito, Ecuador
Tel: 529684, TLX. 2865

Proteco Coasin Cia., Ltda
Calderon 103 y Malecon
Casilla #9733
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Appendix 7A
Manual Change Information

INTRODUCTION

This appendix contains information necessary to backdate the manual to conform with earlier pcb configurations. To identify the configuration of the pcb's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pcb assembly. Table 7A-1 defines the assembly revision levels documented in this manual.

NEWER INSTRUMENTS

As changes and improvements are made to the instrument they are identified by incrementing the revision letter marked on the affected pcb assembly. These changes are documented on a supplemental change/errata sheet, which, when applicable, is inserted at the front of the manual.

OLDER INSTRUMENTS

To backdate this manual to conform with earlier assembly revision levels, perform the changes indicated in Table 7A-1.

CHANGES

There are no backdating changes at this printing. All pcb assemblies are documented at their original revision level.

Table 7A-1. Manual Status and Backdating Information

Ref Or Option No.	Assembly Name	Fluke Part No.	* To adapt manual to earlier rev configurations perform changes in desending order (by no.), ending with change under desired rev letter														
			–	A	B	C	D	E	F	G	H	J	K	L	M	N	P
A1	Mother Board PCB Assy	409425	●	●	●	●	X										
A2	Power Supply PCB Assy (115/230V ac)	409433	●	●	●	●	●	●	●	●	●	X					
A2	Power Supply PCB Assy (100V ac)	426676	●	●	●	●	●	●	●	●	●	X					
A3	Controller PCB Assy	451013	●	●	●	X											
A4	Guard Crossing PCB Assy	409458	●	●	●	●	X										
A5	Printer Drive PCB Assy	409482	●	●	●	●	●	X									
A6	Display PCB Assy	409490	●	●	●	●	●	●	X								
A7	Mode Switch PCB Assy	502252	X														
A8	Basic Programmer PCB Assy	502260	●	X													
A9	Block Programmer/Memory PCB Assy	502278	●	X													
A10	High Performance A/D Converter PCB Assy	409599	●	●	●	●	●	●	●	●	●	●	X				
A11	Temperature PCB Assy	409565	●	●	●	X											

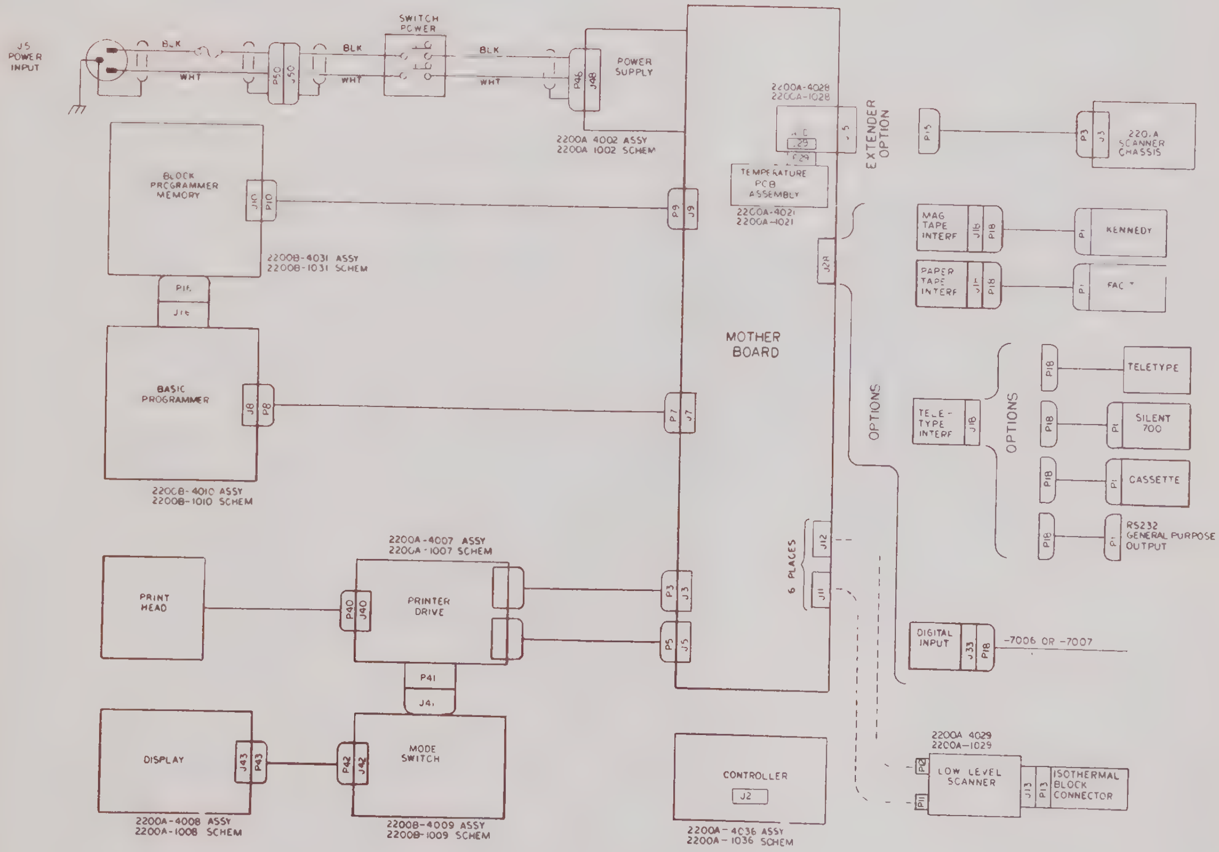
* X = The PCB revision levels documented in this manual.
● = These revision letters were never used in the instrument.
–= No revision letter on the PCB.

Section 8

Schematic Diagrams

TABLE OF CONTENTS

FIGURE	TITLE	PAGE
8-1	System Cable Connections	8-2
8-2	A1 Mother Board PCB Assembly	8-4
8-3	A2 Power Supply PCB Assembly	8-6
8-4	A3 Controller PCB Assembly	8-8
8-5	A5 Printer Drive PCB Assembly	8-12
8-6	A6 Display PCB Assembly	8-14
8-7	A7 Mode Switch PCB Assembly	8-16
8-8	A8 Basic Programmer PCB Assembly	8-18
8-9	A4 Guard Crossing PCB Assembly	8-20
8-10	A11 Temperature PCB Assembly	8-23
8-11	A9 Block Programmer/Memory PCB Assembly	8-24
8-12	A10 High Performance A/D Converter PCB Assembly	8-26
8-13	Mnemonics	8-28
	Low Level Scanner (See Section 6, Option -06)	
	Isothermal Block Connector (See Section 6, Option -08)	


J5
POWER
INPUT
BLK
WHT
P50
J50
BLK
WHT
SWITCH
POWER
BLK
WHT
P46
J48
POWER
SUPPLY
2200A 4002 ASSY
2200A 1002 SCHEM
2200A-4028
2200A-1028
J5
J29
P29
EXTENDER
OPTION
TEMPERATURE
PCB
ASSEMBLY
2200A-4021
2200A-1021
P15
P3
J3
2204A
SCANNER
CHASSIS
BLOCK
PROGRAMMER
MEMORY
J10
P10
P9
J9
2200B-4031 ASSY
2200B-1031 SCHEM
P16
J16
J28
MAG
TAPE
INTERF
J16
P18
P1
KENNEDY
PAPER
TAPE
INTERF
J17
P18
P1
FAC
MOTHER
BOARD
BASIC
PROGRAMMER
J8
P8
P7
J7
2200B-4010 ASSY
2200B-1010 SCHEM
OPTIONS
TELE-
TYPE
INTERF
J18
OPTIONS
P18
TELETYPE
P18
P1
SILENT
700
P18
P1
CASSETTE
P18
P1
RS232
GENERAL PURPOSE
OUTPUT
2200A-4007 ASSY
2200A-1007 SCHEM
PRINT
HEAD
P40
J40
PRINTER
DRIVE
P3
J3
P5
J5
6 PLACES
J12
J11
DIGITAL
INPUT
J33
P18
-7006 OR -7007
P41
J41
DISPLAY
J43
P43
P42
J42
MODE
SWITCH
2200A-4008 ASSY
2200A-1008 SCHEM
2200B-4009 ASSY
2200B-1009 SCHEM
CONTROLLER
J2
2200A-4036 ASSY
2200A-1036 SCHEM
2200A 4029
2200A-1029
P12
P11
LOW LEVEL
SCANNER
J13
P13
ISOTHERMAL
BLOCK
CONNECTOR

2200B-1301 (1 of 2)

Figure 8-1. System Cable Connections

FUNCTION TABLE

CONNECTOR	PIN NO.	FUNCTION
J2 TEST POINTS ON CONTROLLER (2200A-1036)	1	Ø1
	2	Ø2
	3	RAM 1
	4	STOP ACK
	5	STOP
	6	INT ACK
	7	TEST
	8	N/C
	9	RESET
	10	SYNC
	11	+5V
	12	-10V
	13	D3
	14	D2
	15	D1
J2	16	D0
J4 PRINTER DRIVE (2200A-1007)	1	+5V
	2	UL COMMON
	3	DB1
	4	SYNC
	5	POR
	6	IN STROBE
	7	OUT STROBE
	8	DB 0
	9	DB 3
	10	DB 2
	11	CA 1
	12	CA 0
	13	CA 3
J4	14	CA 2
J6 PRINTER DRIVE (2200A-1007)	1	+16V
	2	+16V
	3	+16 RET
	4	+16 RET
	5	-10V(NOT USED)
	6	-10V
	7	CB1
	8	CB0
	9	CB3
	10	CB2
	11	IAK(NOT USED)
	12	IRQ
	13	ULCOM(N/U)
J6	14	+5V(NOT USED)
J40 PRINTER DRIVE (2200A-1007)	1	N/C
	2	COLUMN 18
	3	N/C
	4	COLUMN 14
	5	12
	6	10
	7	8
	8	6
	9	4
	10	COLUMN 2
	11	N/C
	12	+16V RET
	13	+16V
	14	+16V
	15	RESET
	16	N/C
	17	TL+TP
	18	N/C
	A	N/C
	B	COLUMN 17
	C	N/C
	D	COLUMN 13
	E	11
	F	9
	H	7
	J	5
	K	3
	L	COLUMN 1
	M	N/C
	N	PAPER ADVANCE
	P	+16V
	R	RED RIBBON
	S	N/C
	T	N/C
	U	N/C
J40	V	N/C
P41 PWR SUPPLY (2200A-1002)	1	DB0
	2	DB3
	3	CA2
	4	CA3
	5	CA0
	6	DB1
	7	SYNC
	8	POR
	9	IN STROBE
	10	OUT STROBE
	11	CA1
	12	DB2
	13	+5V
P41	14	UL COMMON

FUNCTION TABLE

CONNECTOR	PIN NO	FUNCTION
J41 MODE SWITCH (2200B-1009)	1	DB0
	2	DB3
	3	CA2
	4	CA3
	5	CA0
	6	DB1
	7	SYNC
	8	POR
	9	IN STROBE
	10	OUT STROBE
	11	CA1
	12	DB2
	13	+5V
J41	14	UL COMMON
J42 MODE SWITCH (2200B-1009)	1	S4
	2	S3
	3	S2
	4	S1
	5	B1
	6	N/C
	7	UL COMMON
	8	N/C
	9	N/C
	10	D
	11	C
	12	B
	13	A
J42	14	+5V
J43 DISPLAY (2200A-1008)	1	S4
	2	S3
	3	S2
	4	S1
	5	B1
	6	N/C
	7	UL COMMON
	8	N/C
	9	N/C
	10	D
	11	C
	12	B
	13	A
J43	14	+5V
J15 A/D {(2200A-1005) (2200A-1028)}	1	CHASSIS COM
	2	N/C
	3	N/C
	4	GUARD
	5	N/C
	6	HS 0
	7	HS 2
	8	DS 0
	9	DS 2
	10	CHS 0
	11	CHS 2
	12	N/C
	13	GL+5V
	14	CL COM(-15V)
	15	A/D COMMON
	16	TEMP SIGNAL
	17	LO
	18	N/C
	19	CHASSIS COM
	20	N/C
	21	N/C
	22	GUARD
	23	N/C
	24	HS1
	25	HS3
	26	DS1
	27	DS3
	28	CHS1
	29	CHS3
	30	+6.2V
	31	GL+5V
	32	GL COM(-15V)
	33	REF COMMON
	34	N/C
	35	+1
J15	36	N/C
P48 POWER SWITCH	1	LINE VOLTAGE
P48	2	EARTH GND
P48	3	LINE VOLTAGE
J50	1	LINE VOLTAGE
J50	2	EARTH GND
J50	3	LINE VOLTAGE
P50 PWR INPUT	1	LINE VOLTAGE
P50	2	EARTH GND
P50	3	LINE VOLTAGE
J48 POWER SUPPLY (2200A-1002)	1	LINE VOLTAGE
J48	2	EARTH GND
J48	3	LINE VOLTAGE

FUNCTION TABLE

CONNECTOR	PIN NO	FUNCTION
J18 MAGNETIC TAPE INTERFACE (2200A-1016)	1	-10V
	2	UL COMMON
	3	+5V
	4	+5V
	5	N/C
	6	SCAN IN PROG
	7	N/C
	8	
	9	
	10	
	11	
	12	N/C
	13	DO0
	14	D30
	15	DO5
	16	DO6
	17	N/C
	18	N/C
	19	READY
	20	WRITE
	21	EOR
	22	UL COMMON
	23	UL COMMON
	24	+5V
	25	+5V
	26	-10V
	27	UL COMMON
	28	+5V
	29	+5V
	30	N/C
	31	START
	32	N/C
	33	N/C
	34	N/C
	35	N/C
	36	GAP IN PRG
	37	PARITY(N/U)
	38	DO1
	39	DO2
	40	DO4
	41	DO7
	42	N/C
	43	N/C
	44	READY
	45	WRITE
	46	7 TRK PARITY
	47	UL COMMON
	48	UL COMMON
	49	+5V
J18	50	+5V
J18 PAPER TAPE INTERFACE (2200A-1015	1	-10V
	2	UL COMMON
	3	+5V
	4	+5V
	5	N/C
	6	SCAN IN PROG
	7	N/C
	8	
	9	
	10	
	11	
	12	N/C
	13	DO0
	14	DO3
	15	DO5
	16	DO6
	17	N/C
	18	N/C
	19	READY
	20	PUNCH
	21	N/C
	22	UL COMMON
	23	UL COMMON
	24	+5V
	25	+5V
	26	-10V
	27	UL COMMON
	28	+5V
	29	+5V
	30	N/C
	31	START
	32	N/C
	33	
	34	
	35	
	36	N/C
	37	PARITY
	38	DO1
	39	DO2
	40	DO4
	41	DO7
	42	N/C
	43	N/C
	44	READY
	45	PUNCH
J18	46	N/C

J18 CONTINUED

FUNCTION TABLE

CONNECTOR	PIN NO	FUNCTION
J18	47	UL COMMON
	48	UL COMMON
	49	+5V
J18	50	+5V
J18 TELETYPE INTERFACE (2200A-1014)	1	-10V
	2	UL COMMON
	3	+5V
	4	+5V
	5	EIA(RS232)
	6	SCAN IN PROG
	7	CURRENT LOOP
	8	CURRENT LOOP
	9	N/C
	10	
	11	
	12	
	13	
	14	
	15	
	16	N/C
	17	DATA SET RDY
	18	CLR TO SEND
	19	N/C
	20	N/C
	21	N/C
	22	UL COMMON
	23	UL COMMON
	24	+5V
	25	+5V
	26	-10V
	27	UL COMMON
	28	+5V
	29	+5V
	30	N/C
	31	START
	32	N/C
	33	
	34	
	35	
	36	
	37	
	38	
	39	
	40	
	41	N/C
	42	DATA SET RDY
	43	CLR TO SEND
	44	N/C
	45	N/C
	46	N/C
	47	UL COMMON
	48	UL COMMON
	49	+5V
J18	50	+5V
J33 DIGITAL INPUT (2200A-1017)	1	N/C
	2	INPUT 4, DB0
	3	DB1
	4	DB2
	5	INPUT 4 DB3
	6	N/C
	7	N/C
	8	INPUT 3, DB3
	9	DB2
	10	DB1
	11	INPUT 3, DB0
	12	N/C
	13	N/C
	14	INPUT 2, DB3
	15	DB2
	16	DB1
	17	INPUT 2 DB0
	18	N/C
	19	N/C
	20	INPUT 1, DB3
	21	DB2
	22	DB1
	23	INPUT 1 DB0
	24	N/C
	25	N/C
	26	N/C
	27	INPUT 9 DB3
	28	DB2
	29	DB1
	30	INPUT 9, DB0
	31	UL COMMON
	32	UL COMMON
	33	INPUT 8, DB0
	34	DB1
	35	DB2
	36	INPUT 8, DB3
	37	+5V
	38	+5V
	39	INPUT 7, DB0
	40	DB1
	41	DB2
J33	42	INPUT 7, DB3

J33 CONTINUED

FUNCTION TABLE

ECTOR	PIN NO.	FUNCTION
	[illegible]	INPUT DB0
	[illegible]	DB1
	[illegible]	DB2
	[illegible]	[illegible] DB3
	[illegible]	[illegible] DB4
	[illegible]	[illegible]
	[illegible]	[illegible]
	[illegible]	[illegible] DB0
KENNEDY INCREMENTAL MAGNETIC RECORDER	1	+5V
	2	[illegible]
	3	[illegible]
	4	N/C
	5	N/C
	6	UL COMMON
	7	UL COMMON
	8	UL COMMON
	9	N/C
	10	[illegible]
	11	UL COMMON
	12	N/C
	13	[illegible] PARITY
	14	WRITE
	15	N/C
	16	[illegible]
	17	DO2
	18	[illegible]
	19	[illegible]
	20	[illegible]
	21	[illegible]
	22	[illegible]
	23	DO7
	24	N/C
	25	N/C
	26	N/C
	27	READY
	28	[illegible] PRG
	29	UL COMMON
	30	ECR
	31-36	N/C
FACIT TAPE PUNCH (4070)	1	DO0
	2	DO1
	3	DO2
	4	DO3
	5	DO4
	6	DO5
	7	DO6
	8	PARITY
	9	+5V
	10	UL COMMON
	11	PUNCH
	12	READY
	[illegible]24	N/C
	25	UL COMMON
TI SILENT 700 DATA TERMINAL (733)	1	N/C
	2	N/C
	3	EIA (RS232)
	4	N/C
	5	-10V
	6	+5V
	7	UL COMMON
	8	+5V
	9	N/C
	10-25	N/C
GEN PURPOSE (RS232) & TECHTRAN DATA CASSETTE (8400 OR 8410)	1	N/C
	2	EIA (RS232)
	3	N/C
	4	+5V
	5	CLR TO SEND
	6	DATA SET RDY
	7	UL COMMON
	8-19	N/C
	20	+5V
	21-25	N/C
29 TEMP OPTION (2200A-1021) 29	1	N/C
	2	RJ
	3	Δ2
	4	GL+5V
	5	6.2V
	6	TEMP SIG
	7	HI
	8	+15V
	9	6.2V IN
	10	REF COMMON
	11	N/C
	12	GL COM(-15V)
	13	OPEN TC
	14	T

FUNCTION TABLE

CONNECTOR	PIN NO.	FUNCTION
J10 [illegible] (2200B-13[illegible]) J10	1	A0
	2	A2
	3	A4 (NOT USED)
	4	A6 (NOT USED)
	5	O1
	6	O3
	7	N/C
	8	KDB MEM SEL
	9	O4
	10	O2
	11	A7 (NOT USED)
	12	A5 (NOT USED)
	13	A3
	14	A1
P16 [illegible] PROGRAMMER (2200B-[illegible]) P16	1	+5
	2	OUT STROBE
	3	DB1
	4	DB2
	5	DB3
	6	DB0
	7	SI-8
	8	SI-4
	9	SI-2
	10	SI-1
	11	POR
	12	UL COMMON
J16 BASIC PROGRAMMER (2200B-1C10) J16	1	+5
	2	OUT STROBE
	3	DB1
	4	DB2
	5	DB3
	6	DB0
	7	SI 8
	8	SI-4
	9	SI-2
	10	SI-1
	11	POR
	12	UL COMMON
J8 BASIC PROGRAMMER (2200B-1C1C) J8	1	+5V
	2	UL COMMON
	3	DB1
	4	SYNC (N/U)
	5	POR
	6	IN STROBE
	7	OUT STROBE
	8	DB0
	9	DB3
	10	DB2
	11	CA1
	12	CA0
	13	CA3
	14	CA2
P11 LOW LEVEL SCANNER (2200A-1029) P11	1	GUARD
	2	GUARD
	3	6.2V
	4	BSX
	5	CS0
	6	CS1
	7	CS2
	8	CS3
	9	GL COM(-15V)
	10	GL COM(-15V)
	11	GL+5V
	12	CL+5V
P12 LOW LEVEL SCANNER (2200A-1029) P12	1	A/D COMMON
	2	REF COMMON
	3	LO
	4	HI
	5	TEMP SIG
	6	SPARE

FUNCTION TABLE

CONNECTOR	PIN NO.	FUNCTION
P13 ISOTHERMAL BLOCK CONNECTOR (2200A-1023) P13	1	H0
	2	S0
	3	L1
	4	GUARD
	5	H2
	6	S2
	7	L3
	8	A/D COM
	9	6.2V
	10	REF COM
	11	S4
	12	H4
	13	GUARD
	14	L5
	15	S6
	16	H6
	17	GUARD
	18	L7
	19	S8
	20	H8
	21	GUARD
	22	L9
	A	L0
	B	GUARD
	C	H1
	D	S1
	E	L2
	F	GUARD
	H	H3
	J	S3
	K	TEMP SIG
	L	BSL
	M	GUARD
	N	L4
	P	S5
	R	H5
	S	GUARD
	T	L6
	U	S7
	V	H7
	W	GUARD
	X	L8
	Y	S9
	Z	H9

2200B-1301 (2 of 2)

Figure 8-1. System Cable Connections (cont)

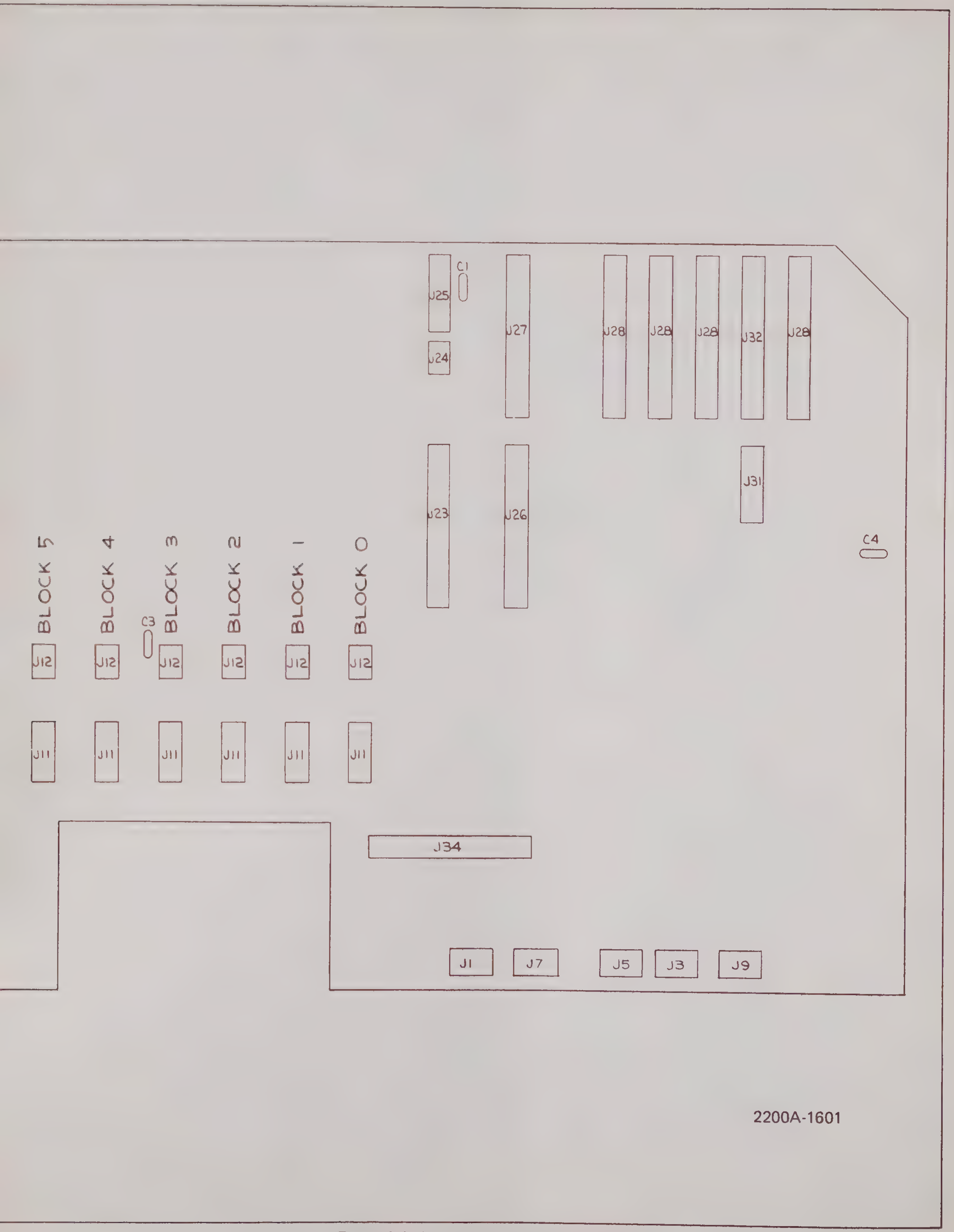
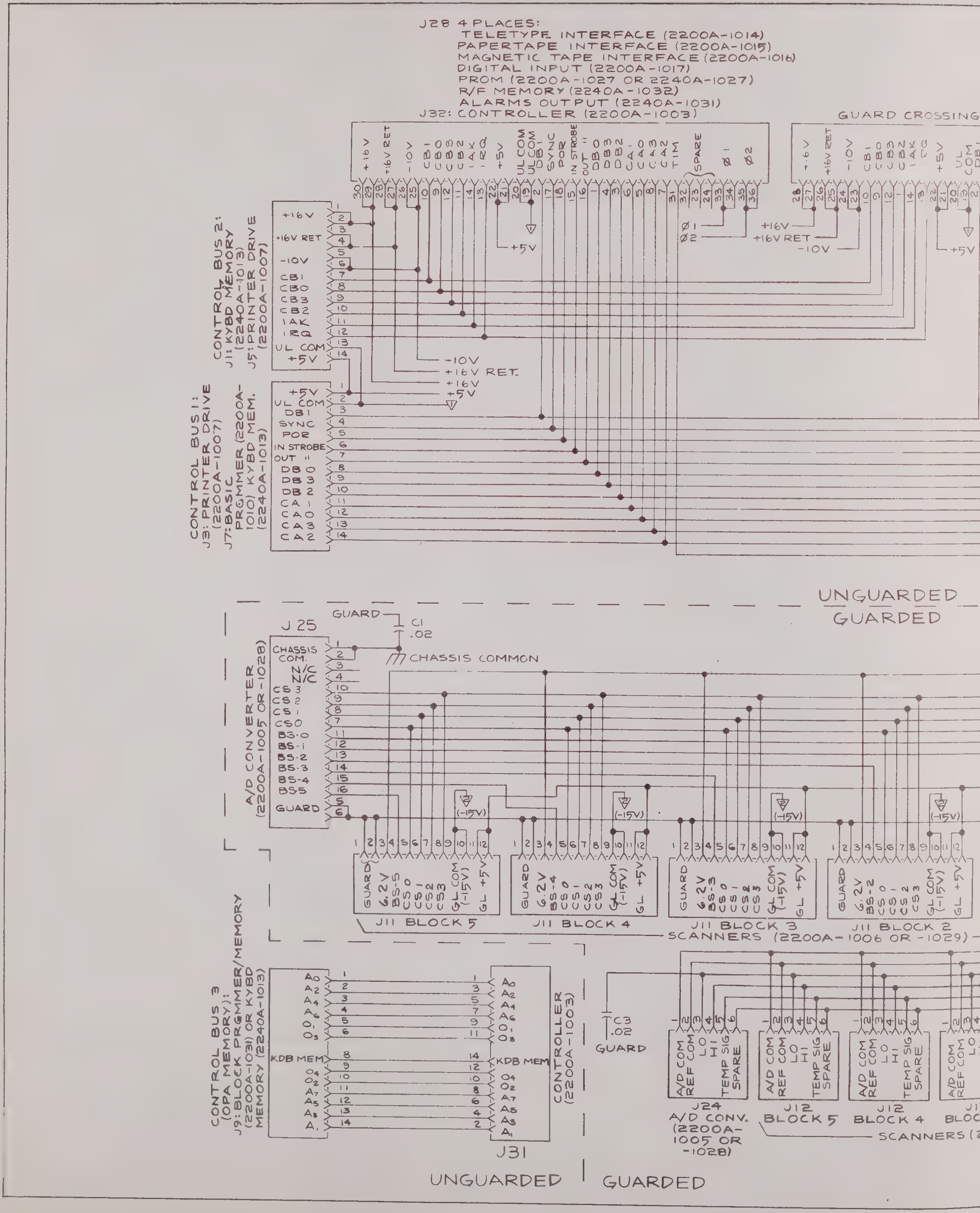
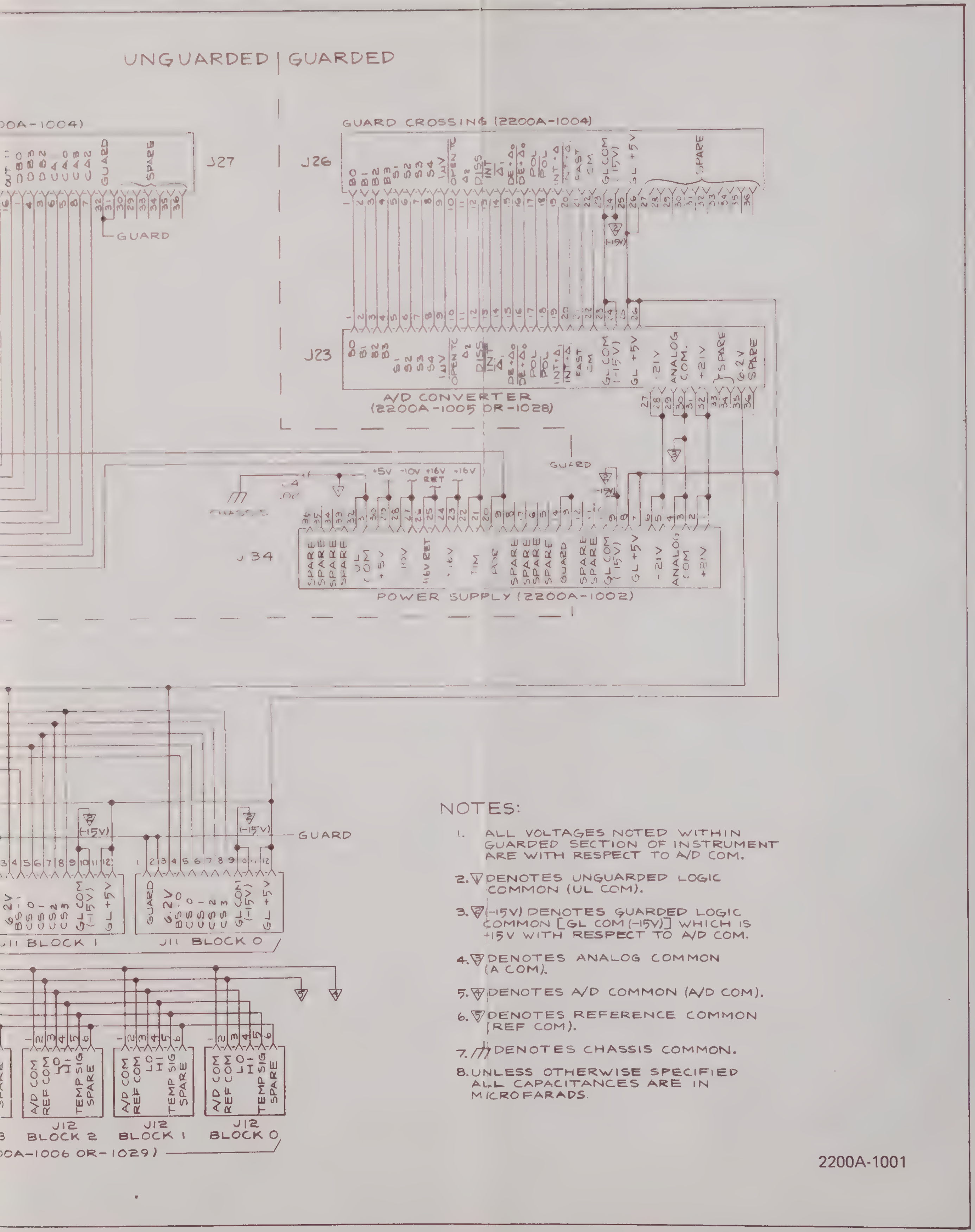

C1
J25
J24
J27
J28
J28
J28
J32
J28
J31
J23
J26
C4
BLOCK 5
BLOCK 4
C3
BLOCK 3
BLOCK 2
BLOCK 1
BLOCK 0
J12
J12
J12
J12
J12
J12
J11
J11
J11
J11
J11
J11
J34
J1
J7
J5
J3
J9
2200A-1601

Figure 8-2. A1 Mother Board PCB Assembly


J28 4 PLACES:
TELETYPE INTERFACE (2200A-1014)
PAPERTAPE INTERFACE (2200A-1015)
MAGNETIC TAPE INTERFACE (2200A-1016)
DIGITAL INPUT (2200A-1017)
PROM (2200A-1027 OR 2240A-1027)
R/F MEMORY (2240A-1032)
ALARMS OUTPUT (2240A-1031)
J32: CONTROLLER (2200A-1003)
GUARD CROSSING
+16V
+16V RET
-10V
CB1
CB0
CB3
CB2
IAK
IRQ
+5V
UL COM
UL COM
DB1
SYNC
POR
IN STROBE
OUT "
DB0
DB3
DB2
CA1
CA0
CA3
CA2
TIM
SPARE
Ø1
Ø2
CONTROL BUS 2:
J1: KYBD MEMORY (2240A-1013)
J5: PRINTER DRIVE (2200A-1007)
UL COM
-10V
+16V RET.
+16V
+5V
CONTROL BUS 1:
J3: PRINTER DRIVE (2200A-1007)
J7: BASIC PRGMMER (2200A-1010) KYBD MEM. (2240A-1013)
UNGUARDED
GUARDED
GUARD
C1
.02
CHASSIS COMMON
J25
A/D CONVERTER (2200A-1005 OR -1028)
CHASSIS COM.
N/C
N/C
CS3
CS2
CS1
CS0
BS-0
BS-1
BS-2
BS-3
BS-4
BS-5
GUARD
(-15V)
GUARD
6.2V
BS-5
BS-4
BS-3
BS-2
CS0
CS1
CS2
CS3
GL COM (-15V)
GL +5V
J11 BLOCK 5
J11 BLOCK 4
J11 BLOCK 3
J11 BLOCK 2
SCANNERS (2200A-1006 OR -1029)
CONTROL BUS 3 (OPA MEMORY):
J9: BLOCK PRGMMER/MEMORY (2200A-1031) OR KYBD MEMORY (2240A-1013)
A0
A2
A4
A6
O1
O3
KDB MEM
O4
O2
A7
A5
A3
A1
CONTROLLER (2200A-1003)
J31
C3
.02
GUARD
A/D COM
REF COM
LO
HI
TEMP SIG
SPARE
J24
A/D CONV. (2200A-1005 OR -1028)
J12
BLOCK 5
BLOCK 4
SCANNERS
UNGUARDED
GUARDED


UNGUARDED | GUARDED
GUARD CROSSING (2200A-1004)
J27
J26
J23
A/D CONVERTER (2200A-1005 OR-1028)
J34
POWER SUPPLY (2200A-1002)
GUARD
CHASSIS
+5V -10V +16V +16V RET
GL COM (-15V)
GL +5V
ANALOG COM.
+21V
-21V
6.2V SPARE
J11 BLOCK 1
J11 BLOCK 0
J12 BLOCK 2
J12 BLOCK 1
J12 BLOCK 0
A/D COM
REF COM
LO
HI
TEMP SIG
SPARE
(-15V)

NOTES:

1. ALL VOLTAGES NOTED WITHIN GUARDED SECTION OF INSTRUMENT ARE WITH RESPECT TO A/D COM.
2. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).
3. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS +15V WITH RESPECT TO A/D COM.
4. ▽ DENOTES ANALOG COMMON (A COM).
5. ▽ DENOTES A/D COMMON (A/D COM).
6. ▽ DENOTES REFERENCE COMMON (REF COM).
7. /// DENOTES CHASSIS COMMON.
8. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCES ARE IN MICROFARADS.

2200A-1001

Figure 8-2. A1 Mother Board PCB Assembly (cont)

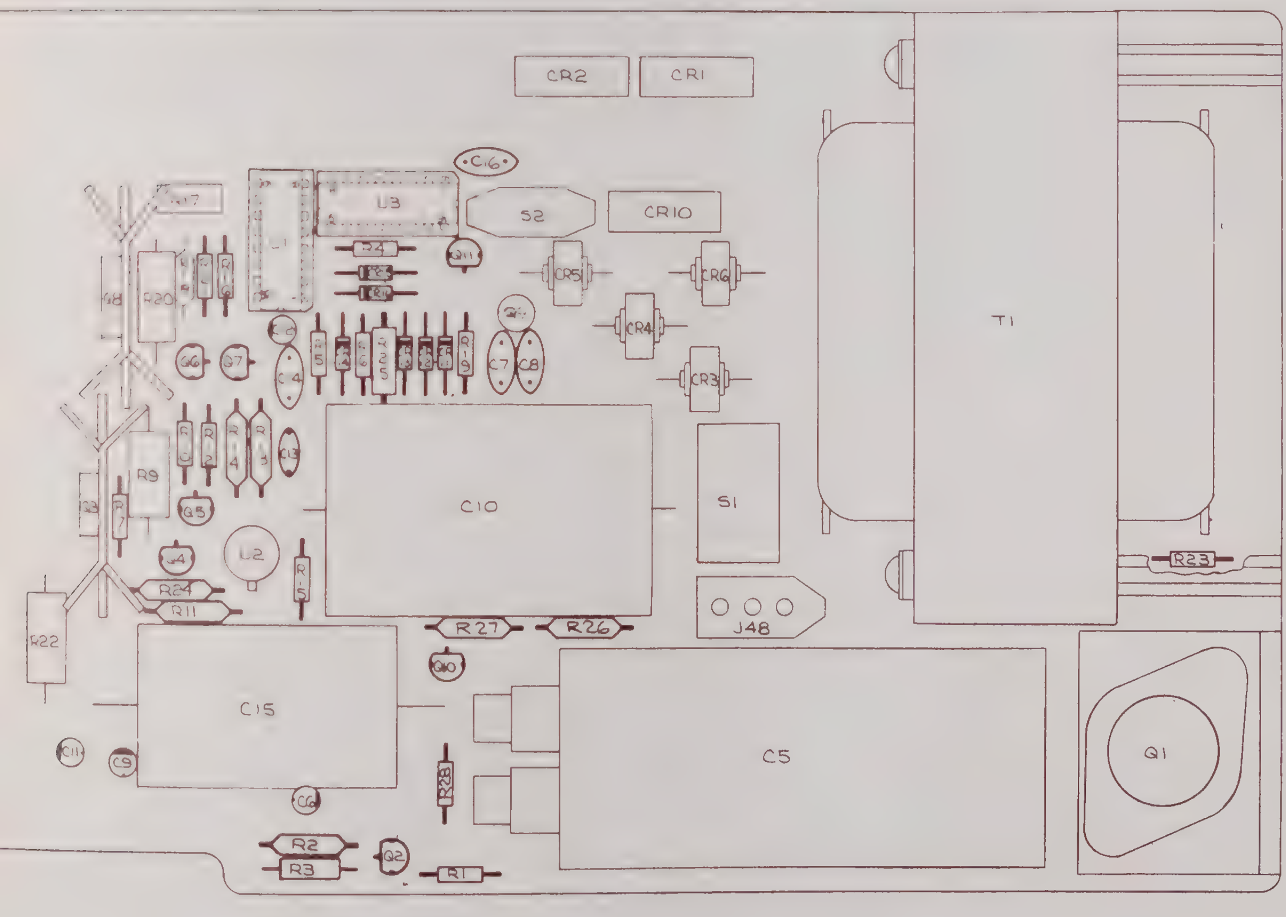
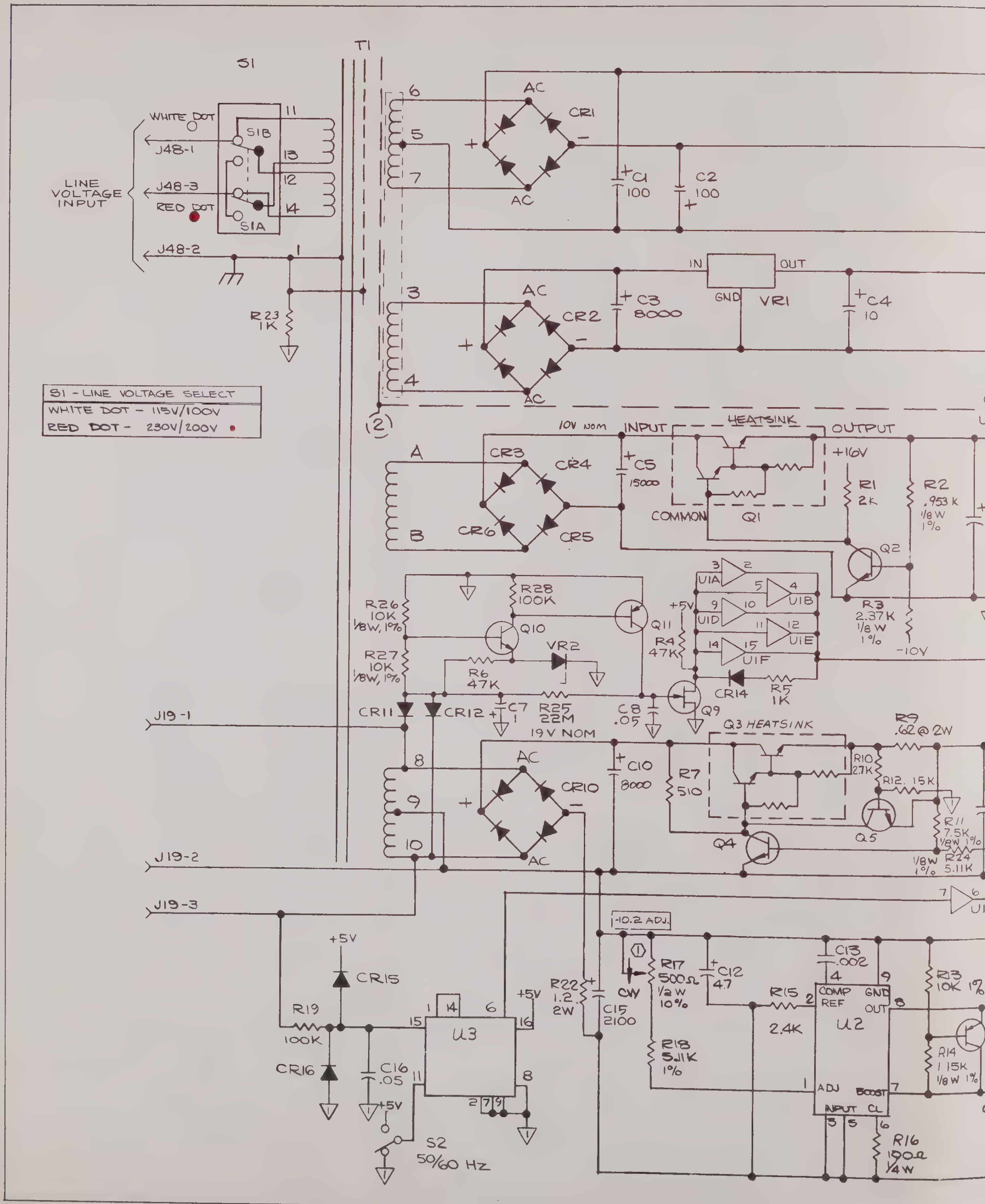
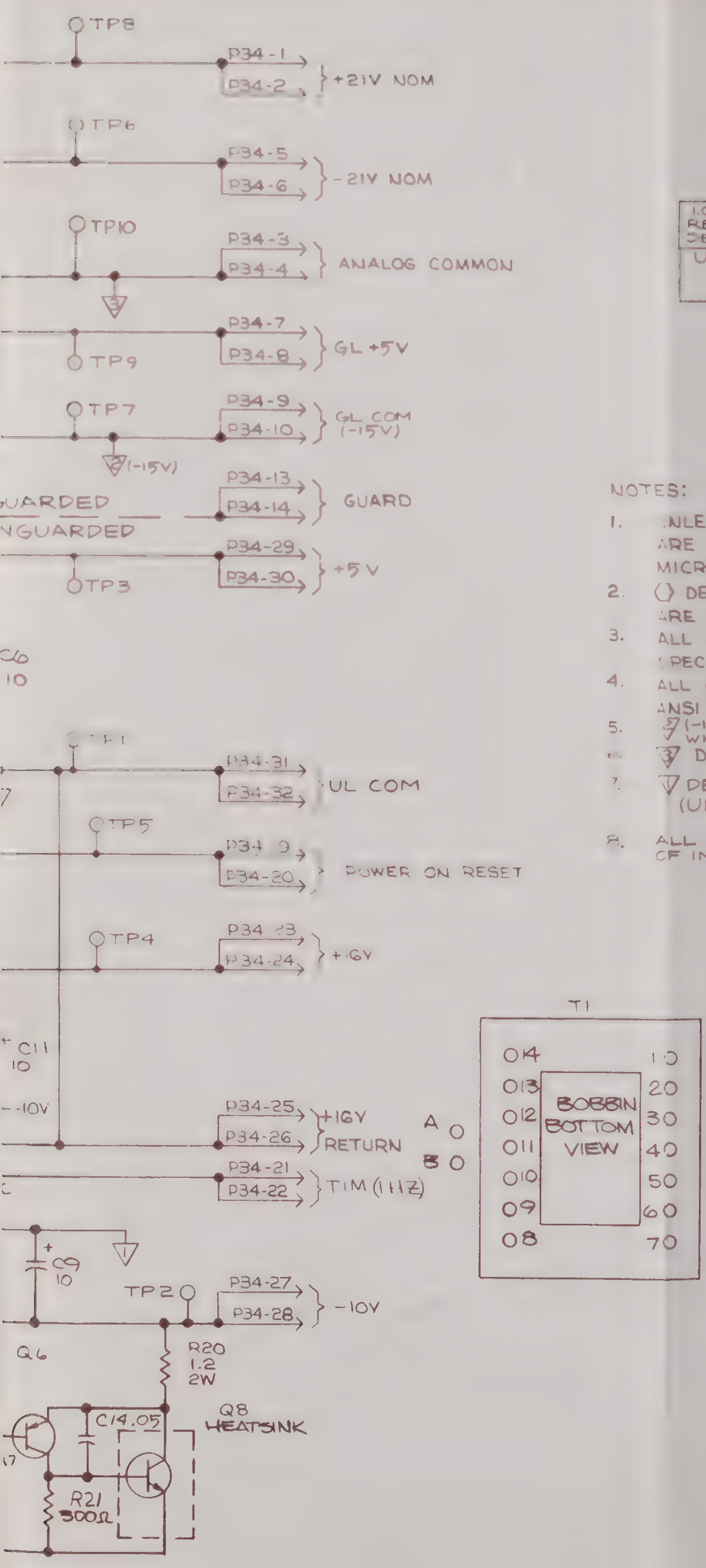

CR2
CR1
C16
U3
S2
CR10
U1
R4
Q11
CR5
CR6
R20
CR4
R5
R25
R19
C7
C8
Q6
Q7
C4
CR3
T1
C13
R9
Q5
C10
S1
U2
Q4
R24
R11
R27
R26
J48
R23
R22
Q10
C15
C5
Q1
C11
C9
C6
R28
R2
R3
Q2
R1
2200A-1602

Figure 8-3. A2 Power Supply PCB Assembly


T1
S1
WHITE DOT
S1B
J48-1
LINE VOLTAGE INPUT
J48-3
RED DOT
S1A
J48-2
11
13
12
14
1
R23 1K
S1 - LINE VOLTAGE SELECT
WHITE DOT - 115V/100V
RED DOT - 230V/200V
6
5
7
AC
CR1
+
-
AC
+C1 100
C2 100 +
IN
OUT
GND
VR1
+C4 10
3
4
AC
CR2
+C3 8000
(2)
10V NOM
INPUT
HEATSINK
OUTPUT
+16V
A
B
CR3
CR4
CR6
CR5
+C5 15000
COMMON
Q1
R1 2K
R2 .953 K 1/8 W 1%
Q2
R3 2.37K 1/8 W 1%
-10V
R28 100K
R26 10K 1/8W, 1%
Q10
Q11
R27 10K 1/8W, 1%
VR2
R6 47K
+5V
R4 47K
U1A
U1B
U1D
U1E
U1F
3 2 5 4 9 10 11 12 14 15
CR14
R5 1K
Q9
J19-1
CR11
CR12
+C7 1
R25 22M
C8 .05
19V NOM
Q3 HEATSINK
R9 .62 @ 2W
8
9
10
AC
CR10
+C10 8000
R7 510
R10 2.7K
R12 15K
Q5
Q4
R11 7.5K 1/8W 1%
R24 5.11K 1/8W 1%
J19-2
J19-3
7 6 U1
-10.2 ADJ.
①
R17 500Ω 1/2 W 10%
CW
+C12 47
C13 .002
R13 10K 1%
R22 1.2 2W
C15 2100
R15 2.4K
R18 5.11K 1%
U2
COMP
REF
GND
OUT
ADJ
BOOST
INPUT
CL
4 9 2 8 1 7 3 5 6
R14 1.15K 1/8 W 1%
R16 190Ω 1/4 W
+5V
CR15
R19 100K
CR16
C16 .05
U3
1 14 6 15 16 11 8 2 7 9
+5V
S2 50/60 Hz


TP8
P34-1
P34-2
+21V NOM
TP6
P34-5
P34-6
-21V NOM
TP10
P34-3
P34-4
ANALOG COMMON
P34-7
P34-8
GL +5V
TP9
TP7
P34-9
P34-10
GL COM (-15V)
(-15V)
P34-13
P34-14
GUARD
UARDED
NGUARDED
P34-29
P34-30
+5V
TP3
C6
10
P34-31
P34-32
UL COM
TP5
P34-19
P34-20
POWER ON RESET
TP4
P34-23
P34-24
+16V
C11
10
-10V
P34-25
P34-26
+16V
RETURN
A
B
P34-21
P34-22
TIM (1HZ)
C9
10
TP2
P34-27
P34-28
-10V
Q6
R20
1.2
2W
C14 .05
Q8
HEATSINK
R21
300Ω
T1
14
13
12
11
10
9
8
1
2
3
4
5
6
7
BOBBIN
BOTTOM
VIEW

I.C. REF. DES.	PIN NO.	
	+5V	UL COM
U1	1,16	8

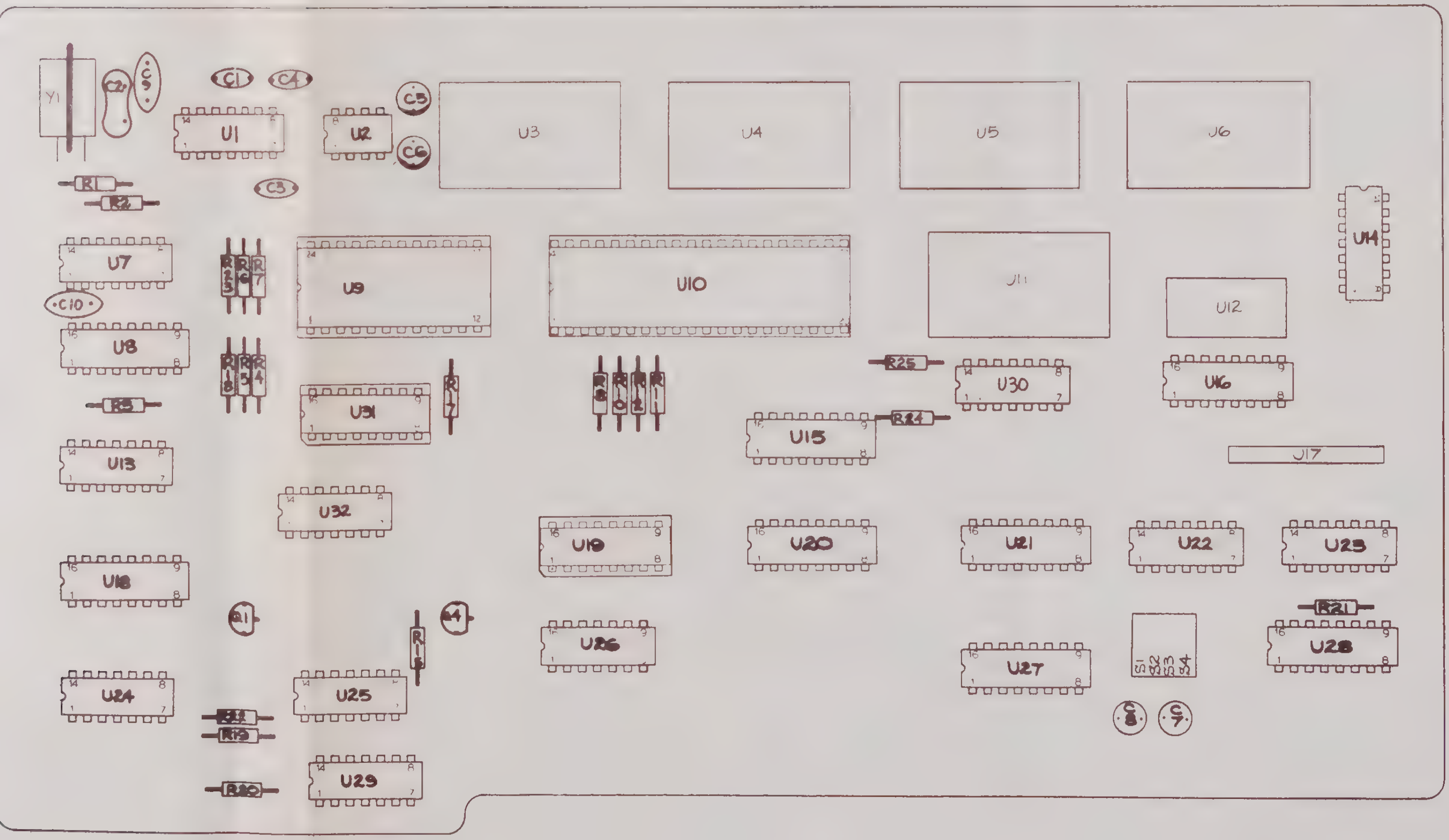
REFERENCE DESIGNATIONS			
LAST USED		NOT USED	
C16 CR16 Q11 R28 S2 T1 TP9	U3 VR2	CR7-9, CR13 R8	

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ◇ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE SPECIFIED.
4. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
6. ▽ DENOTES ANALOG COMMON.
7. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM)
8. ALL VOLTAGES NOTED WITHIN GUARDED SECTION OF INSTRUMENT ARE WITH RESPECT TO A/D COM.

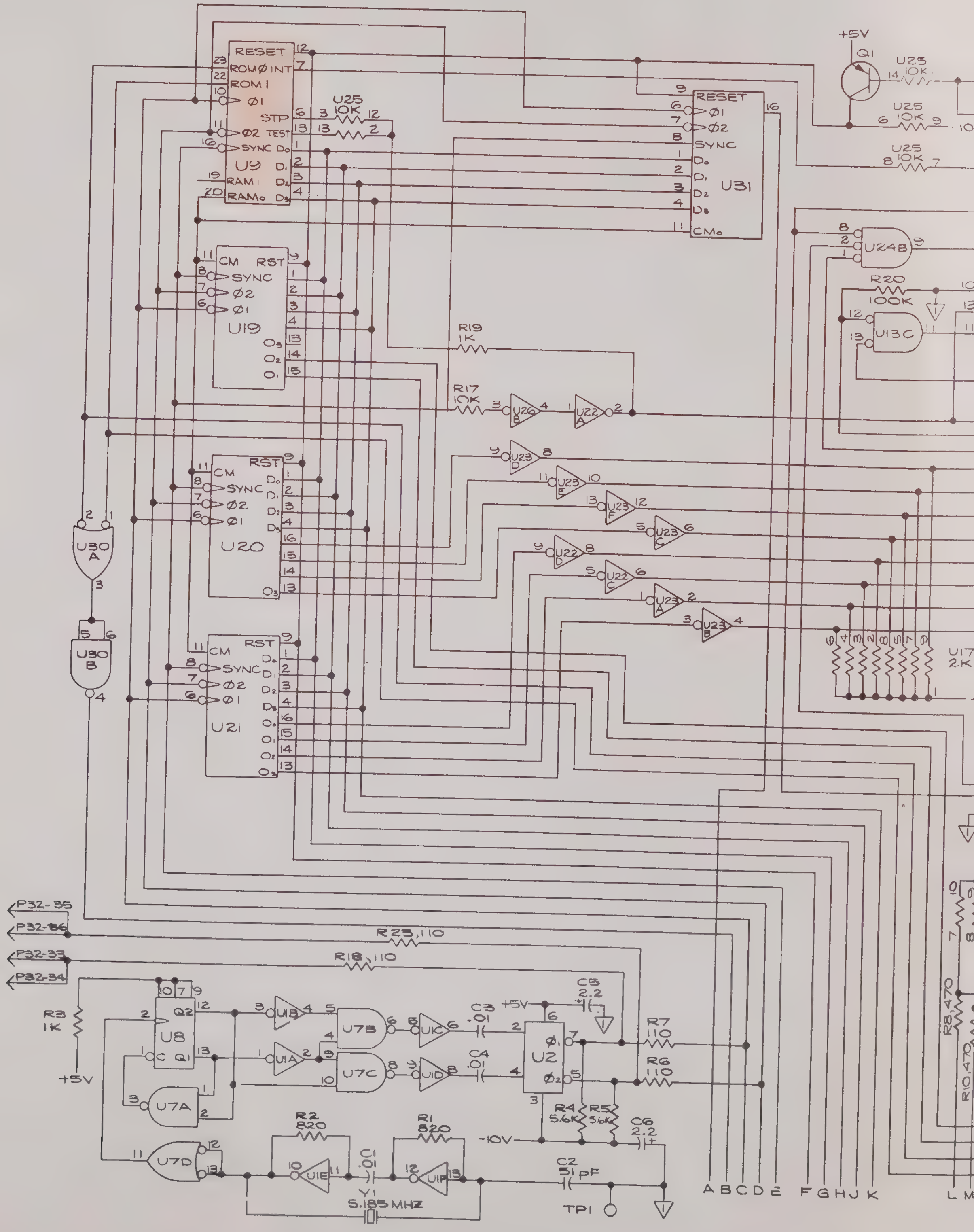
2200A-1002

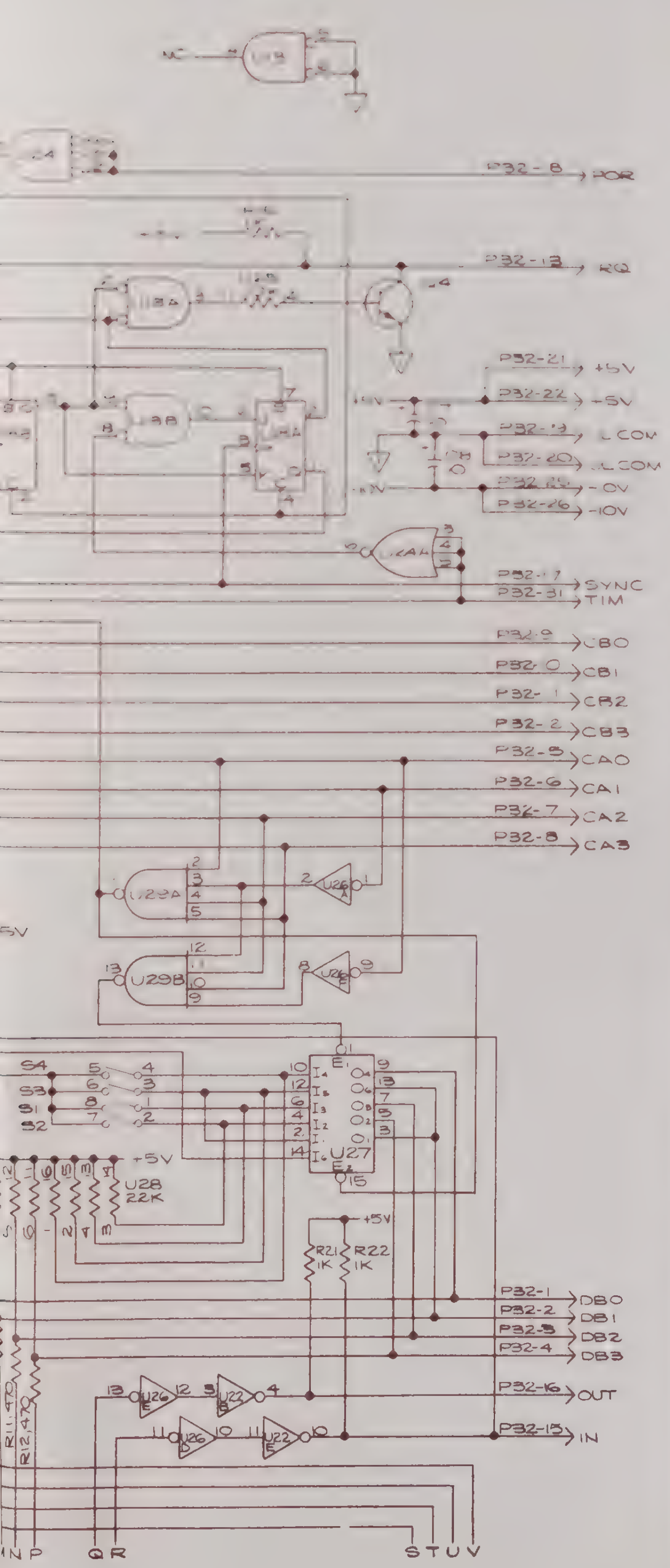
Figure 8-3. A2 Power Supply PCB Assembly (cont)


Y1
C2
C9
C1
C4
C5
C6
C3
U1
U2
U3
U4
U5
U6
R1
R2
U7
R23
R6
R7
U9
U10
U11
U12
U14
C10
U8
R18
R3
R4
R17
R8
R10
R12
R11
R25
U30
U16
R5
U31
U15
R24
U13
J17
U32
U19
U20
U21
U22
U23
U18
Q1
Q4
R15
R21
U26
U28
U27
S1 S2 S3 S4
U24
U25
R22
R19
C8
C7
U29
R20

2200A-1636

Figure 8-4. A3 Controller PCB Assembly


U9
RESET
ROM0
INT
ROM1
Ø1
Ø2
STP
TEST
SYNC
D0
D1
D2
D3
RAM1
RAM0
U25
10K
U31
RESET
Ø1
Ø2
SYNC
D0
D1
D2
D3
CM0
U19
CM
RST
SYNC
O3
O2
O1
R19
1K
R17
10K
U26 B
U22 A
U20
U21
U30 A
U30 B
U23 D
U23 E
U23 F
U23 C
U22 D
U22 C
U23 A
U23 B
+5V
Q1
U25 10K
U25 10K
U25 10K
U24B
R20
100K
U13C
U17
2K
P32-35
P32-36
P32-33
P32-34
R23, 110
R18, 110
R3
1K
+5V
U8
Q2
Q1
C
U1B
U1A
U7B
U7C
U1C
U1D
U7A
U7D
C3
.01
C4
.01
C5
2.2
+5V
U2
Ø1
Ø2
R7
110
R6
110
R4
5.6K
R5
5.6K
C6
2.2
-10V
R2
820
R1
820
U1E
U1F
C1
.01
Y1
5.185 MHZ
C2
51 pF
TP1
A B C D E
F G H J K
L M
R8, 470
R10, 470


P32-8 POR
P32-13 RQ
P32-21 +5V
P32-22 -5V
P32-19 L COM
P32-20 UL COM
P32-25 -OV
P32-26 -10V
P32-17 SYNC
P32-31 TIM
P32-9 CB0
P32-10 CB1
P32-11 CB2
P32-12 CB3
P32-5 CA0
P32-6 CA1
P32-7 CA2
P32-8 CA3
U18A
U18B
U14A
U24A
U29A
U29B
U26A
U26B
S4
S3
S1
S2
U27
U28 22K
+5V
R21 1K
R22 1K
R11,470
R12,470
P32-1 DB0
P32-2 DB1
P32-3 DB2
P32-4 DB3
U26E
U22B
U26D
U22E
P32-16 OUT
P32-15 IN
N P
Q R
S T U V

IC REF DES	PIN NO.			IC REF DES	PIN NO.		
	+5V	ULCOM	-10V		+5V	ULCOM	-10V
U1	14	7	—	U17	1	—	—
U2	6	–	3	U18	6	8,10	—
U3	24,21	12	—	U19	5,10	–	12
U4	24,21	12	–	U20	5	–	10,12
U5	24,21	12	—	U21	5,10	–	12
U6	24,21	12	—	U22	14	7	—
U7	14	7	—	U23	14	7	—
U8	16	8	—	U24	14	7	—
U9	9	–	14,15,21	U25	2,5,12	–	9
U10	20	35	40	U26	14	7	—
U11	—	–	16,24	U27	16	8	—
U12	16	8	—	U28	9-16	—	—
U13	14	7	—	U29	14	7	—
U14	14		–	U30	14	—	7
U15	16	8	—	U31	5	—	10,12
U16	16	8	—	U32	14	7	—
LAST USED REF DES				NOT USED REF DES			
U32,C10,R25,S4,Y1							

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.
5. WARNING: ⦸ INDICATES USAGE OF MOS DEVICE(S) WHICH MAY BE DAMAGED BY STATIC DISCHARGE. USE SPECIAL HANDLING PER S.O.P. 15.7.

CAUTION
SUBJECT TO DAMAGE BY
STATIC ELECTRICITY

2200A-1036 (1 of 2)

Figure 8-4. A3 Controller PCB Assembly (cont)

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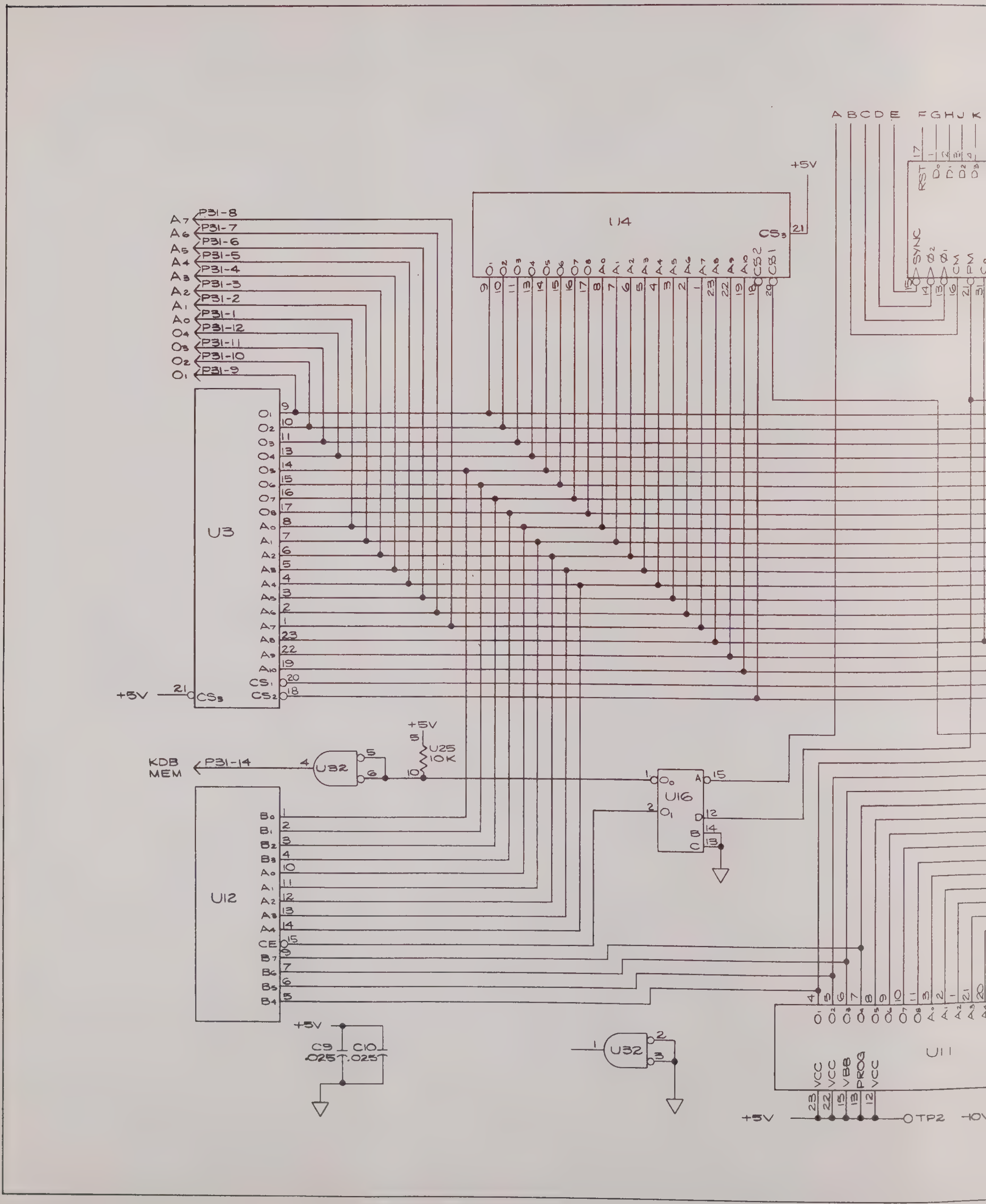
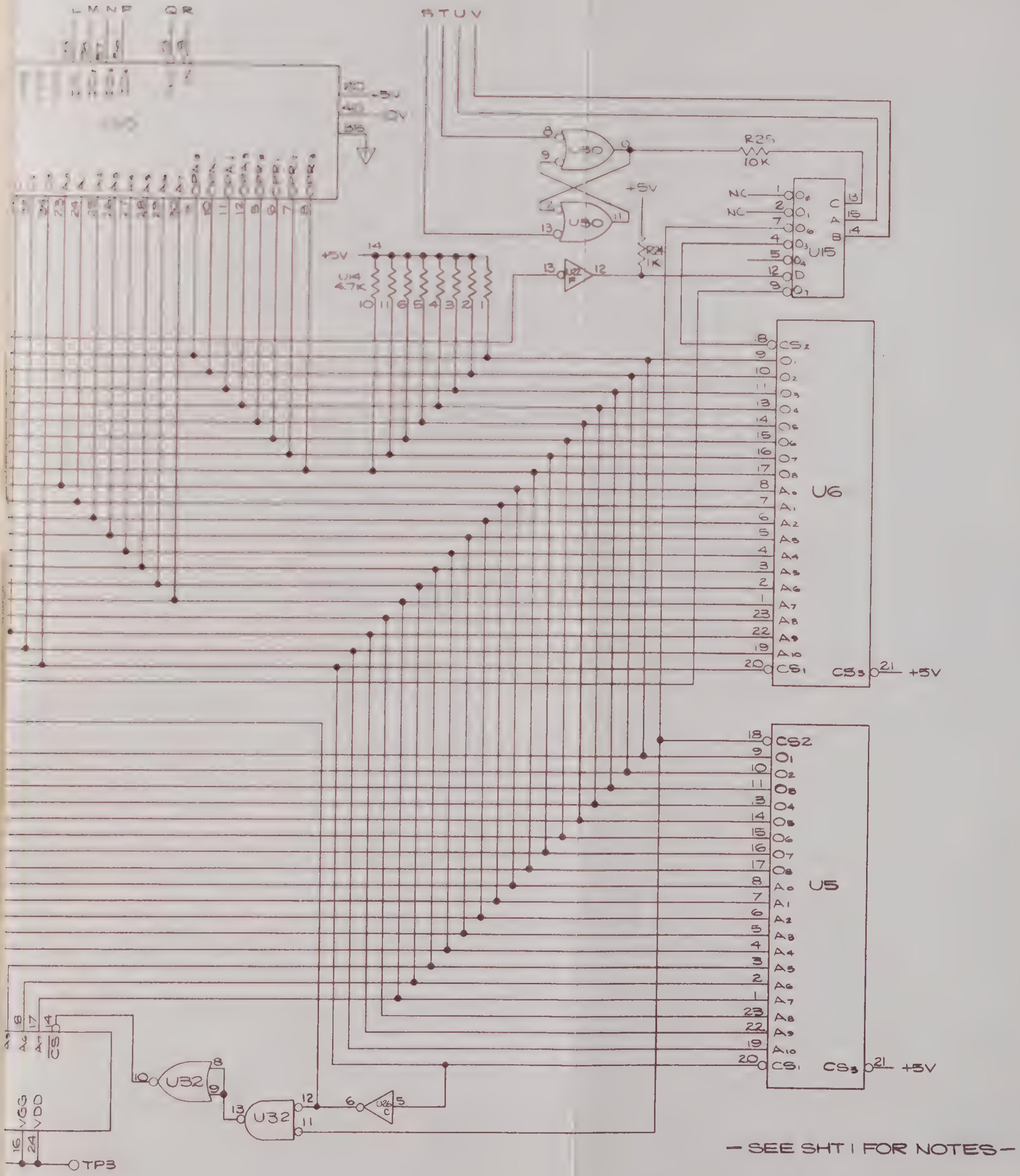
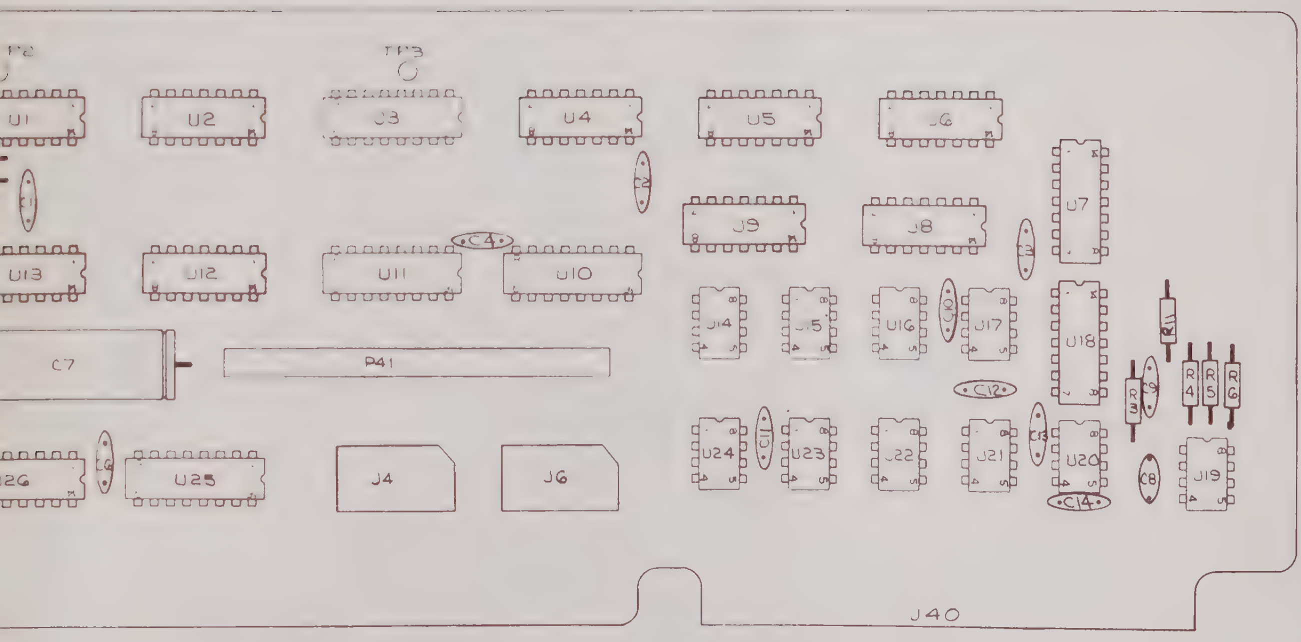

U4
CS3
21
+5V
A B C D E
F G H J K
RST
D0
D1
D2
D3
SYNC
Ø2
Ø1
CM
PM
A7 P31-8
A6 P31-7
A5 P31-6
A4 P31-5
A3 P31-4
A2 P31-3
A1 P31-2
A0 P31-1
O4 P31-12
O3 P31-11
O2 P31-10
O1 P31-9
U3
O1 O2 O3 O4 O5 O6 O7 O8
A0 A1 A2 A3 A4 A5 A6 A7 A8 A9 A10
CS1
CS2
CS3
CS52
CS1
+5V
KDB MEM
P31-14
U32
+5V
U25 10K
U16
O0
O1
A
D
B
C
U12
B0 B1 B2 B3
A0 A1 A2 A3 A4
CE
B7 B6 B5 B4
+5V
C9 .025
C10 .025
U32
U11
VCC
VCC
VBB
PROG
VCC
+5V
TP2
-10V


L M N P
Q R
S T U V
+5V
0V
U30
U30
R25
10K
+5V
R24
1K
U22
U14
4.7K
U15
NC
NC
C
A
B
D
U6
CS₂
O₁
O₂
O₃
O₄
O₅
O₆
O₇
O₈
A₀
A₁
A₂
A₃
A₄
A₅
A₆
A₇
A₈
A₉
A₁₀
CS₁
CS₃
+5V
U5
CS2
+5V
U32
U32
U26
C
VGG
VDD
TP3

— SEE SHT 1 FOR NOTES —

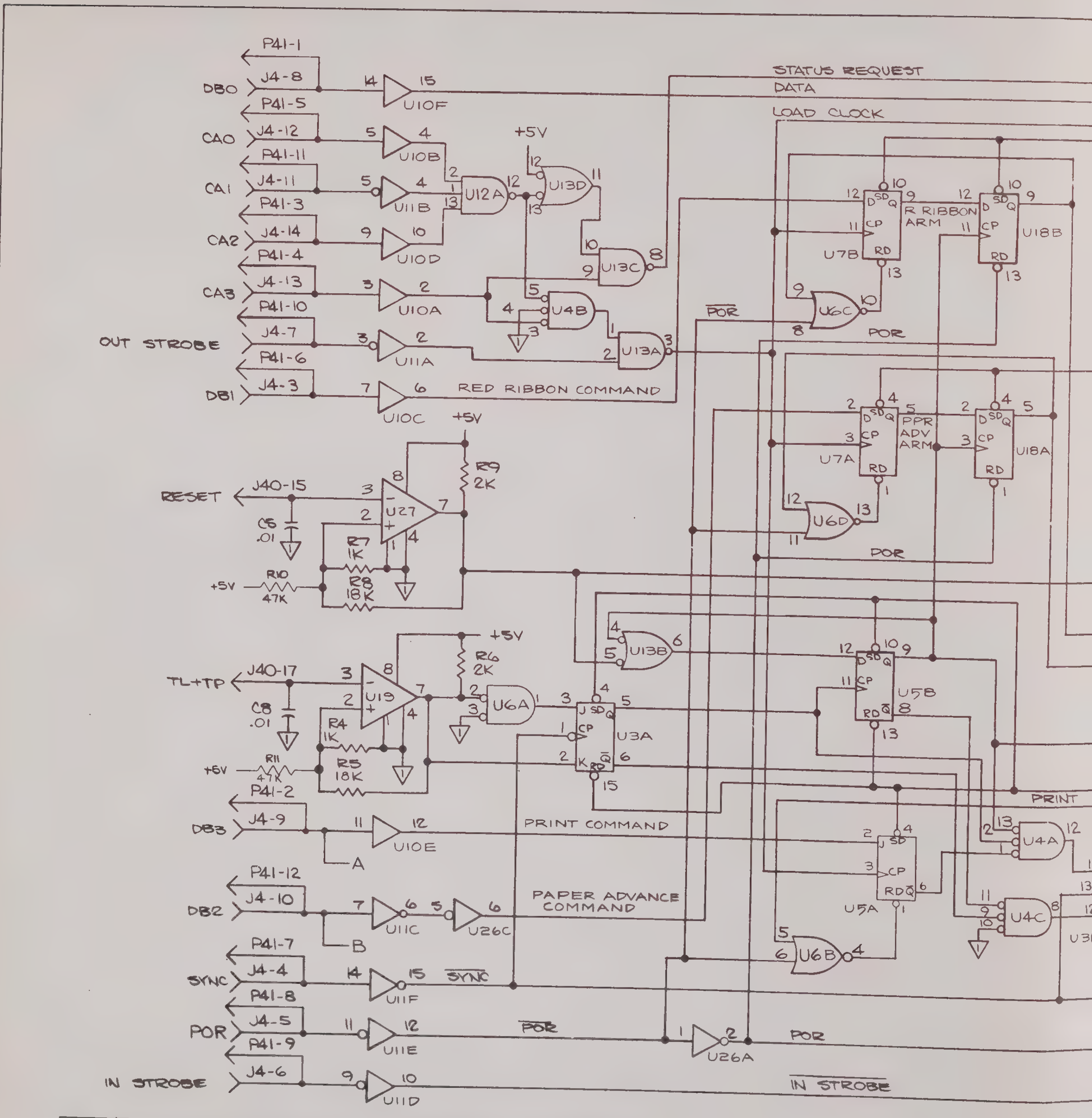
2200A-1036 (2 of 2)

Figure 8-4. A3 Controller PCB Assembly (cont)


TP2
TP3
U1
U2
U3
U4
U5
U6
C1
C2
U9
U8
U7
C3
U13
U12
U11
C4
U10
U14
U15
U16
C10
U17
U18
R11
C7
P41
C12
C9
R3
R4
R5
R6
U26
C6
U25
J4
J6
U24
C11
U23
U22
U21
C13
U20
C8
U19
C14
J40

2200A-1607

Figure 8-5. A5 Printer Drive PCB Assembly


P41-1
J4-8
DBO
14
15
U10F
STATUS REQUEST
DATA
LOAD CLOCK
P41-5
J4-12
CAO
5
4
U10B
+5V
P41-11
J4-11
CA1
U11B
U12A
U13D
U13C
P41-3
J4-14
CA2
9
10
U10D
P41-4
J4-13
CA3
3
2
U10A
U4B
U13A
P41-10
OUT STROBE
J4-7
U11A
P41-6
J4-3
DB1
7
6
U10C
RED RIBBON COMMAND
U7B
R RIBBON ARM
U18B
U6C
POR
U7A
PPR ADV ARM
U18A
U6D
+5V
R9
2K
RESET
J40-15
U27
C6
.01
R7
1K
R8
18K
R10
47K
+5V
U13B
U5B
+5V
R6
2K
TL+TP
J40-17
U19
U6A
U3A
C8
.01
R4
1K
R5
18K
R11
47K
+5V
P41-2
J4-9
DB3
11
12
U10E
PRINT COMMAND
A
PRINT
U4A
U5A
P41-12
J4-10
DB2
7
6
5
6
U11C
U26C
PAPER ADVANCE COMMAND
B
U4C
U6B
U3
P41-7
J4-4
SYNC
14
15
U11F
SYNC
P41-8
J4-5
POR
11
12
U11E
POR
1
2
U26A
POR
P41-9
J4-6
IN STROBE
9
10
U11D
IN STROBE
+16
+16V RE
+5V
UL
CO

I.C. REF. DES.	PIN NO. +5V	PIN NO. UL COM	PIN NO. +16V RET	I.C. REF. DES.	PIN NO. +5V	PIN NO. UL COM	PIN NO. +16V RET
U1	14	7	—	U15	8	—	4
U2	14	7	—	U16	8	—	4
U3	16	8	—	U17	8	—	4
U4	14	7	—	U18	14	7	—
U5	14	7	—	U19			
U6	14	7	—	U20	8	—	4
U7	14	7	—	U21	8	—	4
U8	14	7	—	U22	8	—	4
U9	14	7	—	U23	8	—	4
U10	1,16	8	—	U24	8	—	4
U11	1,16	8	—	U25	16	—	8
U12	14	7	—	U26	14	—	7
U13	14	7	—	U27			
U14	8	—	4				

REFERENCE DESIGNATIONS	
LAST USED	NOT USED
C14 Q1 R9 U27	

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.2. AND Y32.14.

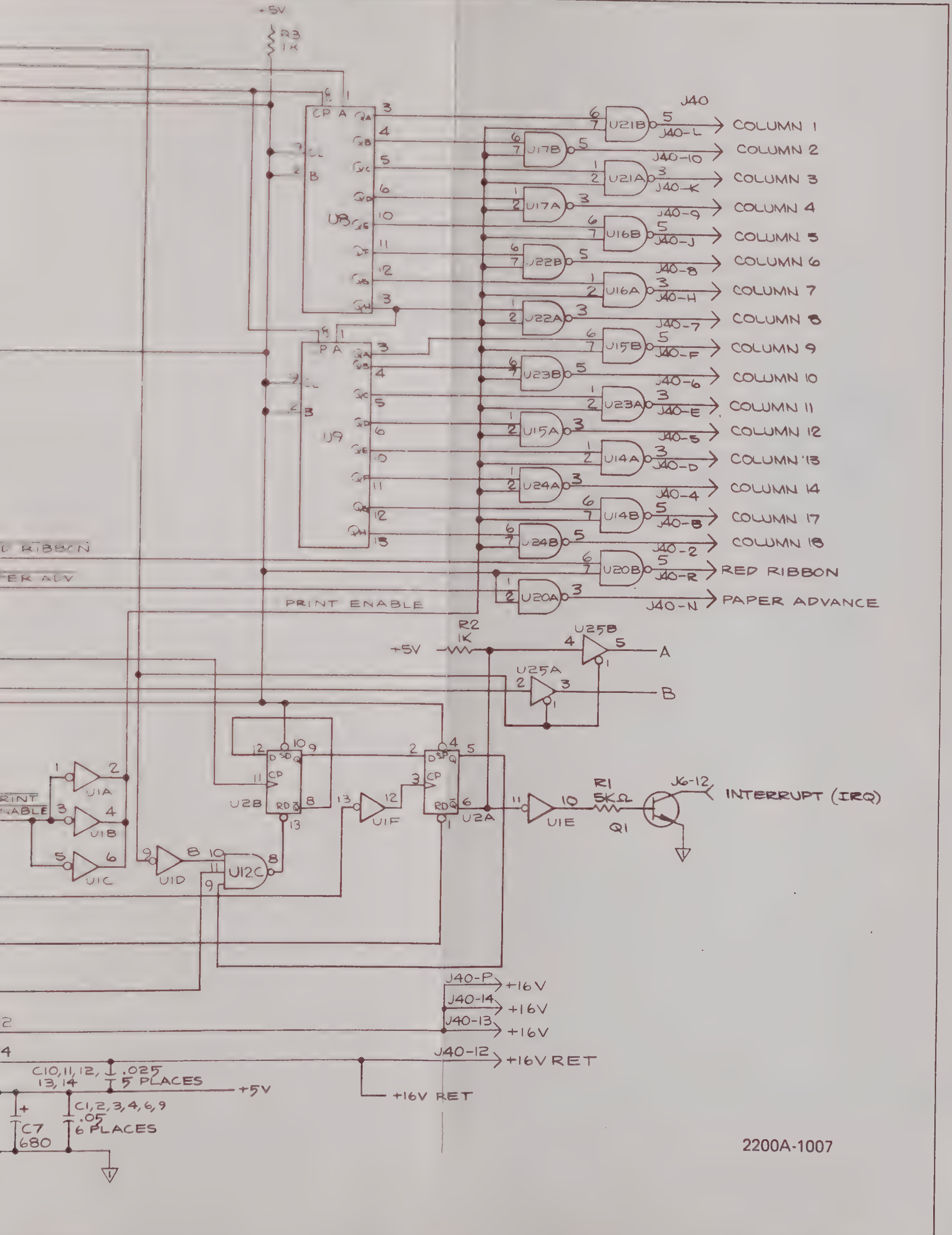
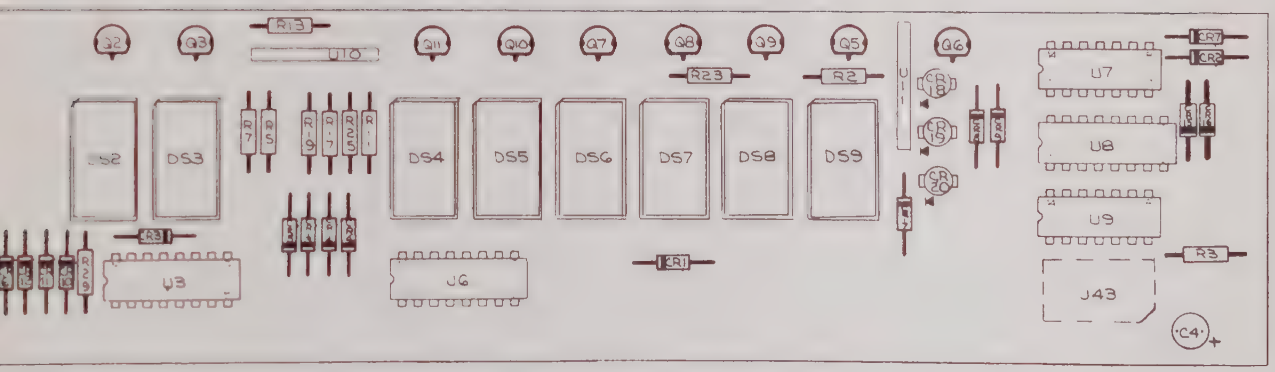
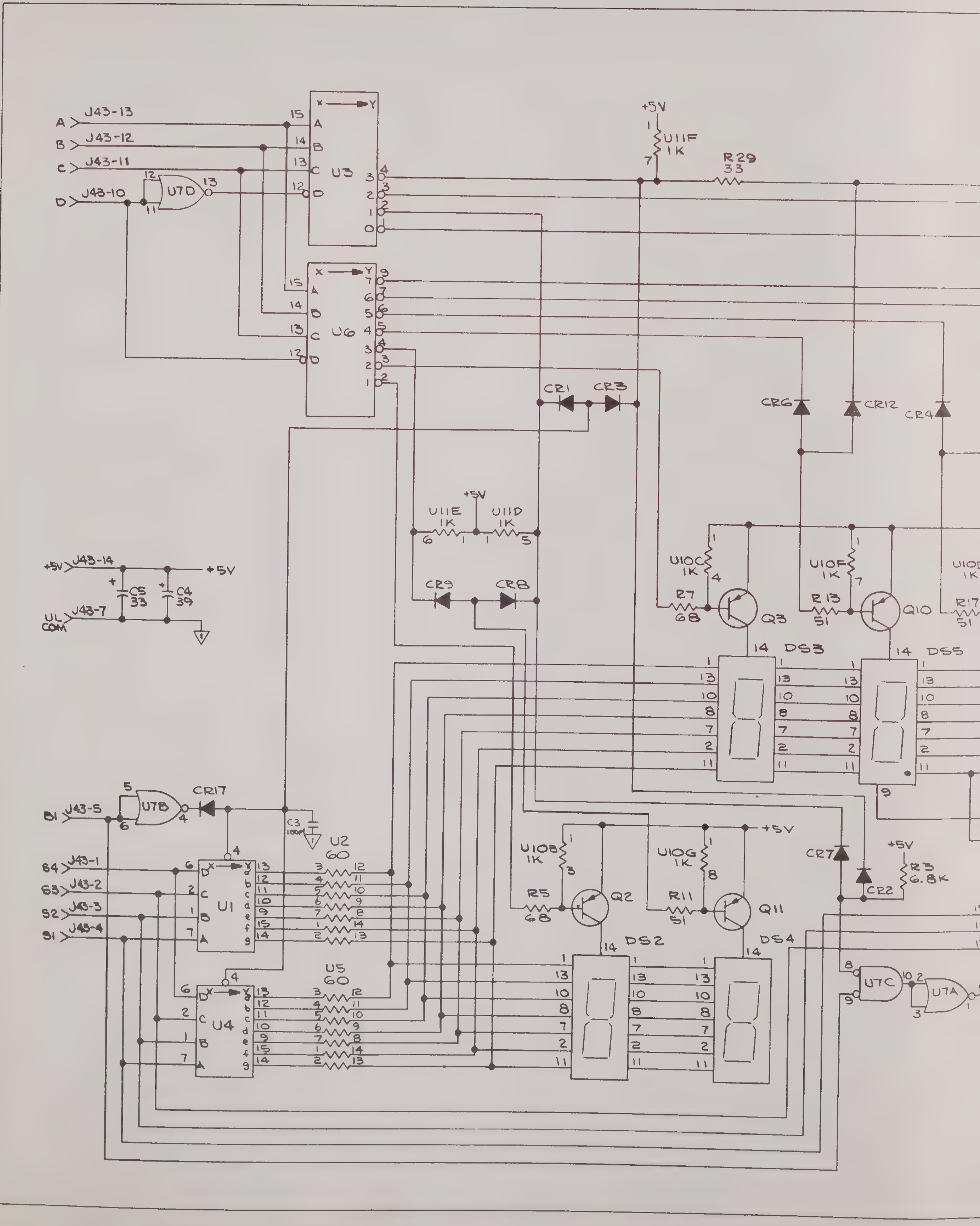

+5V
R3
1K
U8
U9
CP A
CL
B
P A
J40
U21B
U17B
U21A
U17A
U16B
U22B
U16A
U22A
U15B
U23B
U23A
U15A
U14A
U24A
U14B
U24B
U20B
U20A
J40-L
J40-10
J40-K
J40-9
J40-J
J40-8
J40-H
J40-7
J40-F
J40-6
J40-E
J40-5
J40-D
J40-4
J40-B
J40-2
J40-R
J40-N
COLUMN 1
COLUMN 2
COLUMN 3
COLUMN 4
COLUMN 5
COLUMN 6
COLUMN 7
COLUMN 8
COLUMN 9
COLUMN 10
COLUMN 11
COLUMN 12
COLUMN 13
COLUMN 14
COLUMN 17
COLUMN 18
RED RIBBON
PAPER ADVANCE
PRINT ENABLE
RIBBON
PER ADV
R2
1K
+5V
U25B
U25A
A
B
U1A
U1B
U1C
U1D
U1E
U1F
U2B
U2A
U12C
PRINT
ENABLE
R1
5KΩ
Q1
J6-12
INTERRUPT (IRQ)
J40-P
+16V
J40-14
+16V
J40-13
+16V
J40-12
+16V RET
+16V RET
C10,11,12,
13,14
.025
5 PLACES
+5V
C7
680
C1,2,3,4,6,9
.05
6 PLACES
2200A-1007

Figure 8-5. A5 Printer Drive PCB Assembly (cont)


Q2
Q3
R13
U10
Q11
Q10
Q7
Q8
Q9
Q5
Q6
U7
CR7
CR2
R23
R2
U11
CR18
CR19
CR20
DS3
R7
R5
R19
R17
R25
R11
DS4
DS5
DS6
DS7
DS8
DS9
U8
U9
CR3
U3
R29
U6
CR1
R3
J43
C4
+

2200A-1608

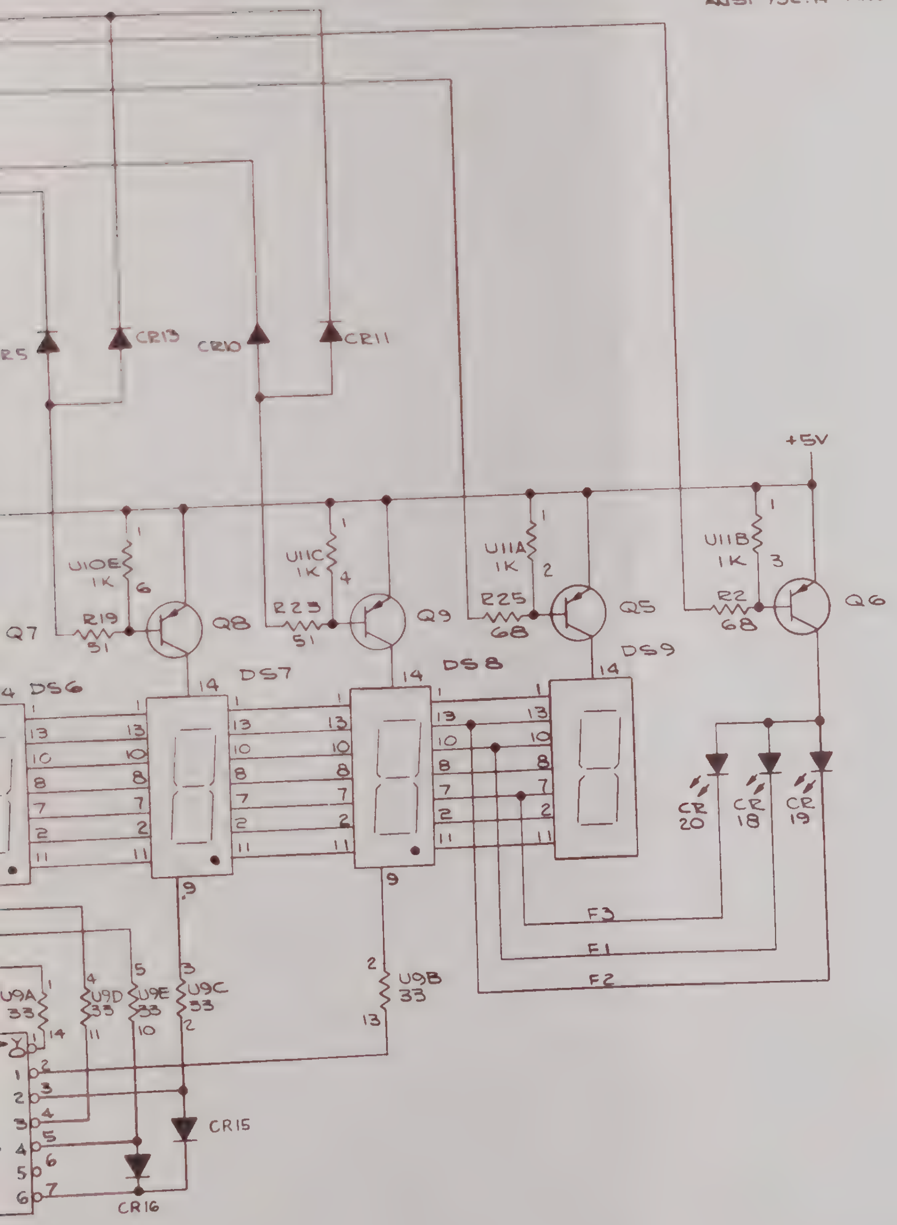
Figure 8-6. A6 Display PCB Assembly


A J43-13
B J43-12
C J43-11
D J43-10
U7D
U3
X → Y
U6
+5V
U11F 1K
R29 33
CR1
CR3
CR6
CR12
CR4
U11E 1K
U11D 1K
CR9
CR8
U10C 1K
R7 68
Q3
U10F 1K
R13 51
Q10
U10D 1K
R17 51
DS3
DS5
+5V J43-14
+5V
C5 33
C4 39
UL COM J43-7
B1 J43-5
U7B
CR17
C3 100pf
U2 60
S4 J43-1
S3 J43-2
S2 J43-3
S1 J43-4
U1
U4
U5 60
U10B 1K
R5 68
Q2
U10G 1K
R11 51
Q11
DS2
DS4
CR7
CR2
R3 6.8K
U7C
U7A

I C REF DES	PIN NO +5V	PIN NO UL COM
U1	16	8
U3	16	8
U4	16	8
U6	16	8
U7	14	7
U8	16	8

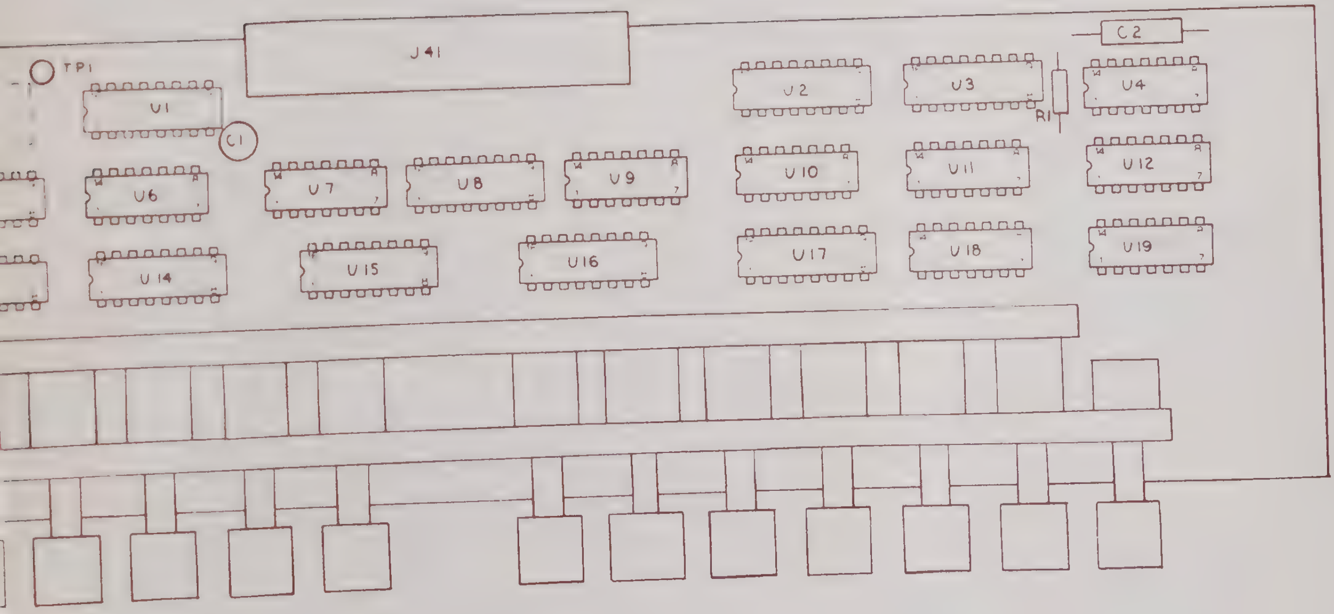
NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS & ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽1 DENOTES UNGUARDED LOGIC COMMON (UL COM)
3. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.


CR13
CR10
CR11
+5V
U10E 1K
U11C 1K
U11A 1K
U11B 1K
R19 51
R23 51
R25 68
R22 68
Q7
Q8
Q9
Q5
Q6
DS6
DS7
DS8
DS9
CR20
CR18
CR19
F3
F1
F2
U9A 33
U9D 33
U9E 33
U9C 33
U9B 33
CR15
CR16

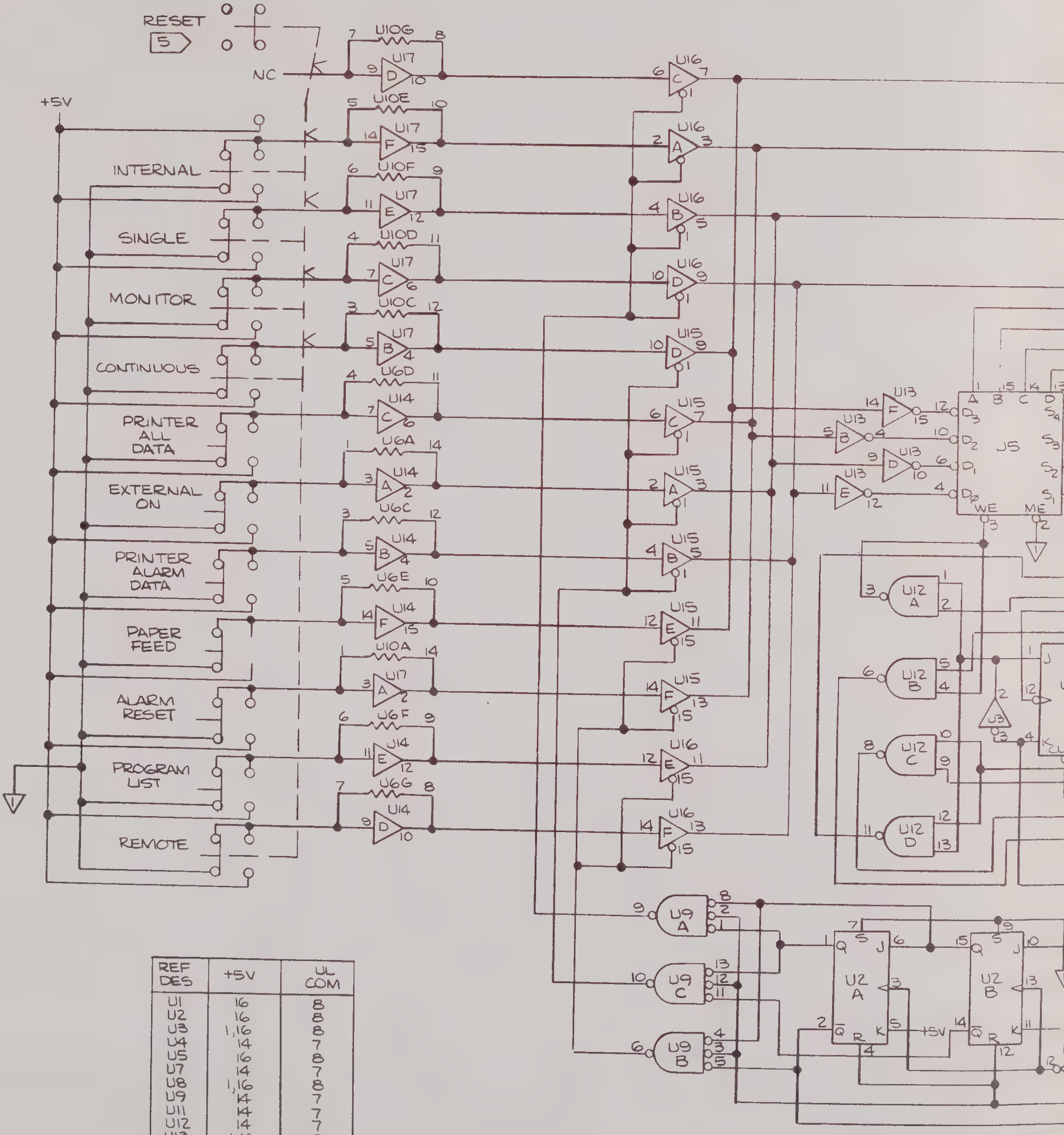
2200A-1008

Figure 8-6. A6 Display PCB Assembly (cont)


TP1
J41
C2
U1
C1
U2
U3
R1
U4
U6
U7
U8
U9
U10
U11
U12
U14
U15
U16
U17
U18
U19

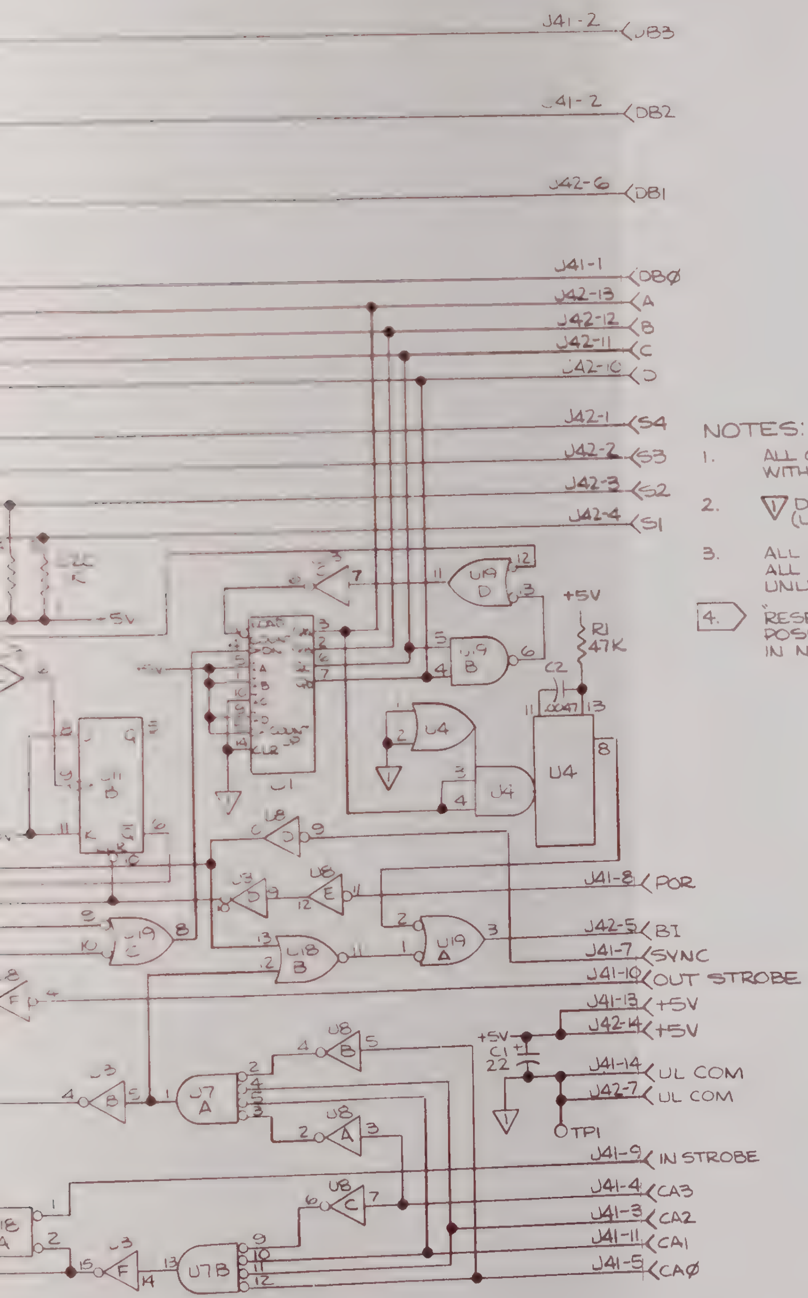
2200B-1609

Figure 8-7. A7 Mode Switch PCB Assembly


RESET
5
NC
+5V
INTERNAL
SINGLE
MONITOR
CONTINUOUS
PRINTER ALL DATA
EXTERNAL ON
PRINTER ALARM DATA
PAPER FEED
ALARM RESET
PROGRAM LIST
REMOTE
K
U10G
U10E
U10F
U10D
U10C
U10A
U6D
U6A
U6C
U6E
U6F
U6G
U17 D
U17 F
U17 E
U17 C
U17 B
U17 A
U14 C
U14 A
U14 B
U14 F
U14 E
U14 D
U16 C
U16 A
U16 B
U16 D
U16 E
U16 F
U15 D
U15 C
U15 A
U15 B
U15 E
U15 F
U13 F
U13 B
U13 D
U13 E
J5
A B C D
D3 D2 D1 D0
S4 S3 S2 S1
WE ME
U12 A
U12 B
U12 C
U12 D
U3
U9 A
U9 C
U9 B
U2 A
U2 B
Q S J
Q̄ R K
+5V

REF DES	+5V	UL COM
U1	16	8
U2	16	8
U3	1,16	8
U4	14	7
U5	16	8
U7	14	7
U8	1,16	8
U9	14	7
U11	14	7
U12	14	7
U13	1,16	8
U14	1,16	8
U15	16	8
U16	16	8
U17	1,16	8
U18	14	7
U19	14	7

REFERENCE DESIGNATION	
LAST USED	NOT USED
C2 R1 U20 TP1	

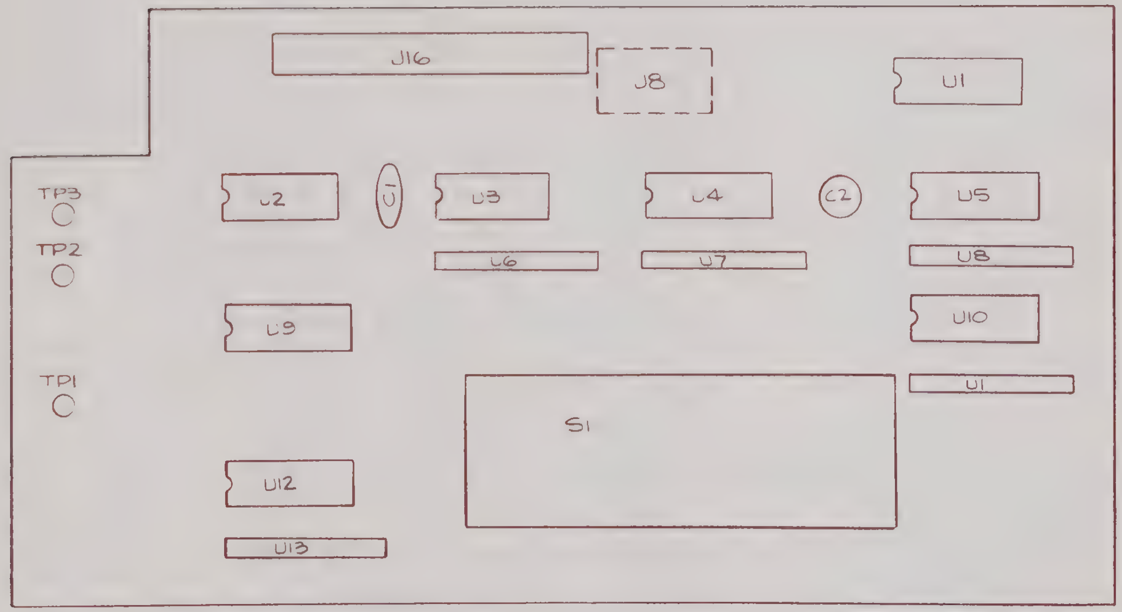

J41-2 DB3
J41-2 DB2
J42-6 DB1
J41-1 DB0
J42-13 A
J42-12 B
J42-11 C
J42-10 D
J42-1 S4
J42-2 S3
J42-3 S2
J42-4 S1
U19 D
U19 B
+5V
R1 47K
C2 .0047
U4
U1
U8
U18 B
U19 C
U19 A
J41-8 POR
J42-5 BI
J41-7 SYNC
J41-10 OUT STROBE
J41-13 +5V
J42-14 +5V
+5V
C1 22
J41-14 UL COM
J42-7 UL COM
TP1
U7 A
U3
J41-9 IN STROBE
J41-4 CA3
J41-3 CA2
J41-11 CA1
J41-5 CA0
U7B
+5V

NOTES:

1. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH Y32.14 AND Y32.2.
2. ∇ DENOTES UNGUARDED COMMON (UL COM.).
3. ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
4. "RESET" SWITCH SHOWN IN DEPRESSED POSITION. ALL OTHER SWITCHES SHOWN IN NONDEPRESSED POSITION.

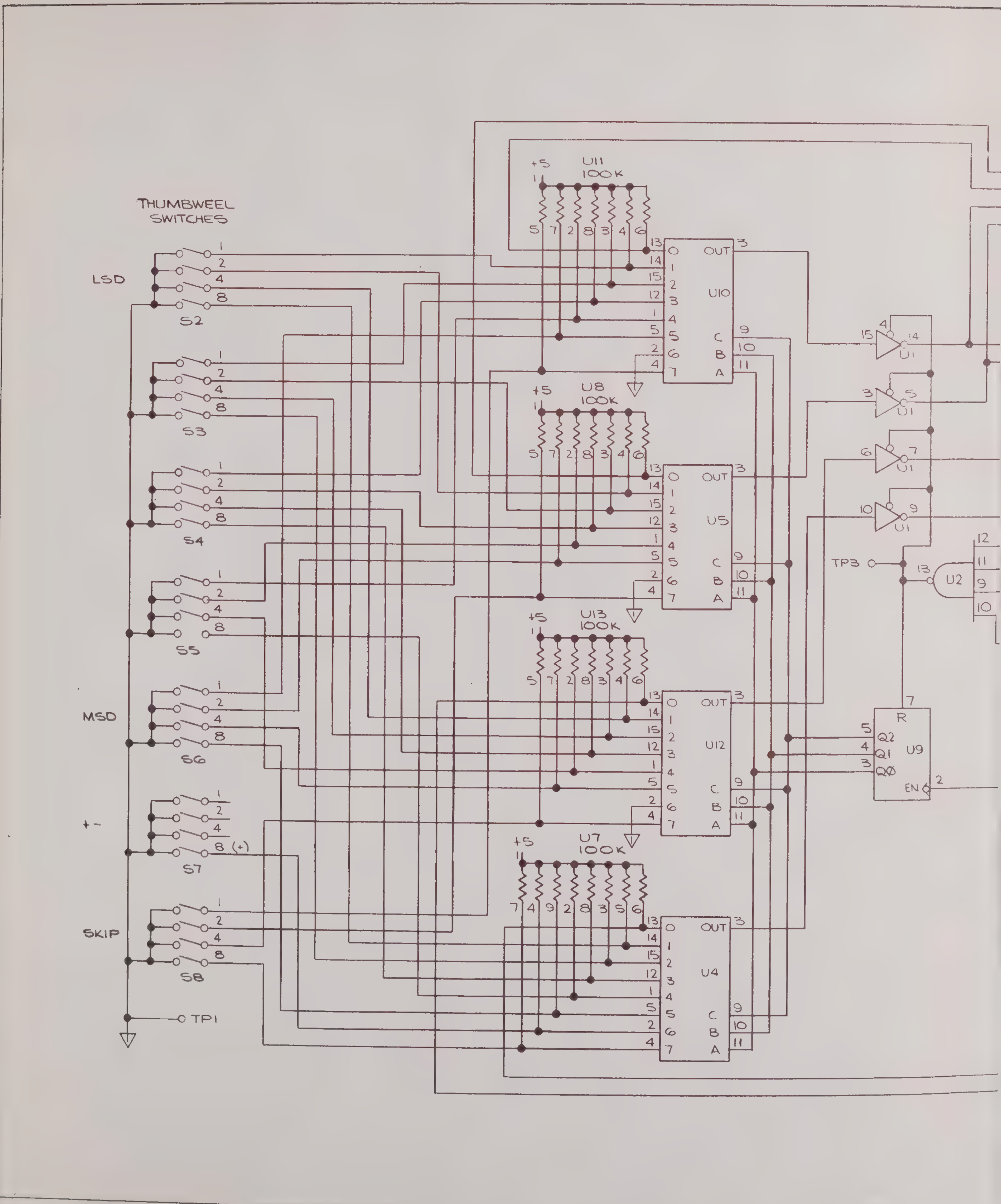
2200B-1009

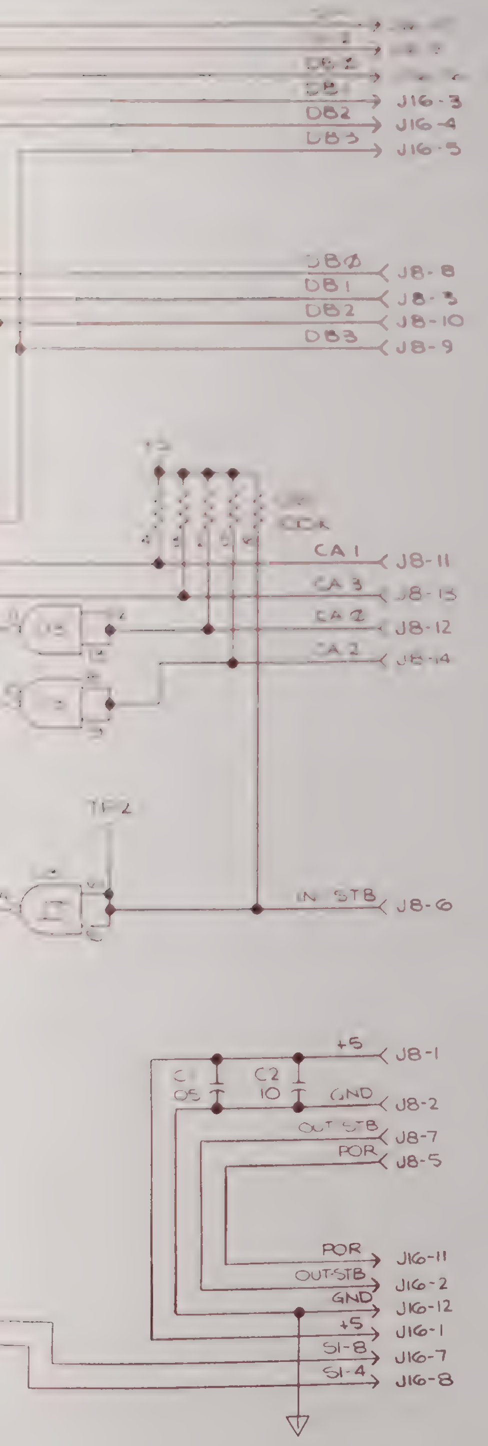
Figure 8-7. A7 Mode Switch PCB Assembly (cont)


J16
J8
U1
TP3
U2
C1
U3
U4
C2
U5
TP2
U6
U7
U8
U9
U10
TP1
U1
S1
U12
U13

2200B-1610

Figure 8-8. A8 Basic Programmer PCB Assembly


THUMBWEEL SWITCHES
LSD
S2
S3
S4
S5
MSD
S6
+ -
8 (+)
S7
SKIP
S8
TP1
+5
U11
100K
U10
OUT
U8
100K
U5
U13
100K
U12
U7
100K
U4
U1
TP3
U2
R
Q2
Q1
Q0
U9
EN


DB2
DB1
J16-3
DB2
J16-4
DB3
J16-5
DB0
J8-8
DB1
J8-3
DB2
J8-10
DB3
J8-9
+5
CA 1
J8-11
CA 3
J8-13
CA 2
J8-12
CA 2
J8-14
TP2
IN STB
J8-6
+5
J8-1
C1
.05
C2
10
GND
J8-2
OUT STB
J8-7
POR
J8-5
POR
J16-11
OUT-STB
J16-2
GND
J16-12
+5
J16-1
S1-8
J16-7
S1-4
J16-8

DIAL	DB3	DB2	DB1	DB0
+	1	X	X	X
−	0	X	X	X

DIAL	DB3	DB2	DB1	DB0
S (SKIP)	X	X	0	0
>	X	X	0	1
<	X	X	1	0

REF DES	GND	+5
U1	1,8,12,13	16
U2	2,3,4,5,7	14
U3	1,2,7	14
U4,5,10,12	6,7,8	16
U6,7,8,11,13		1
U9	1,3,9,10,15	16

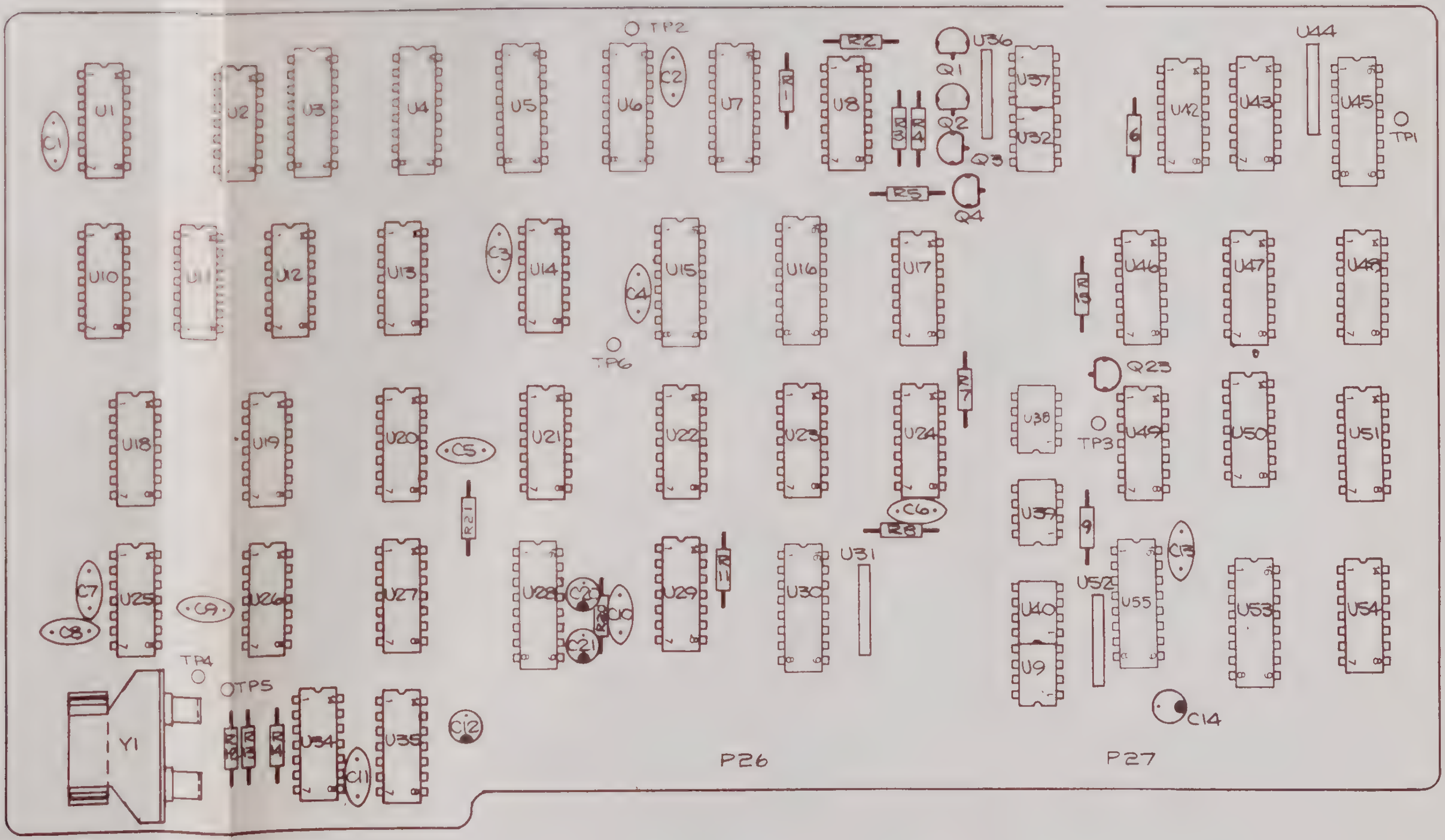
LAST USED	
U13	S8
C2	

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS.
2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.

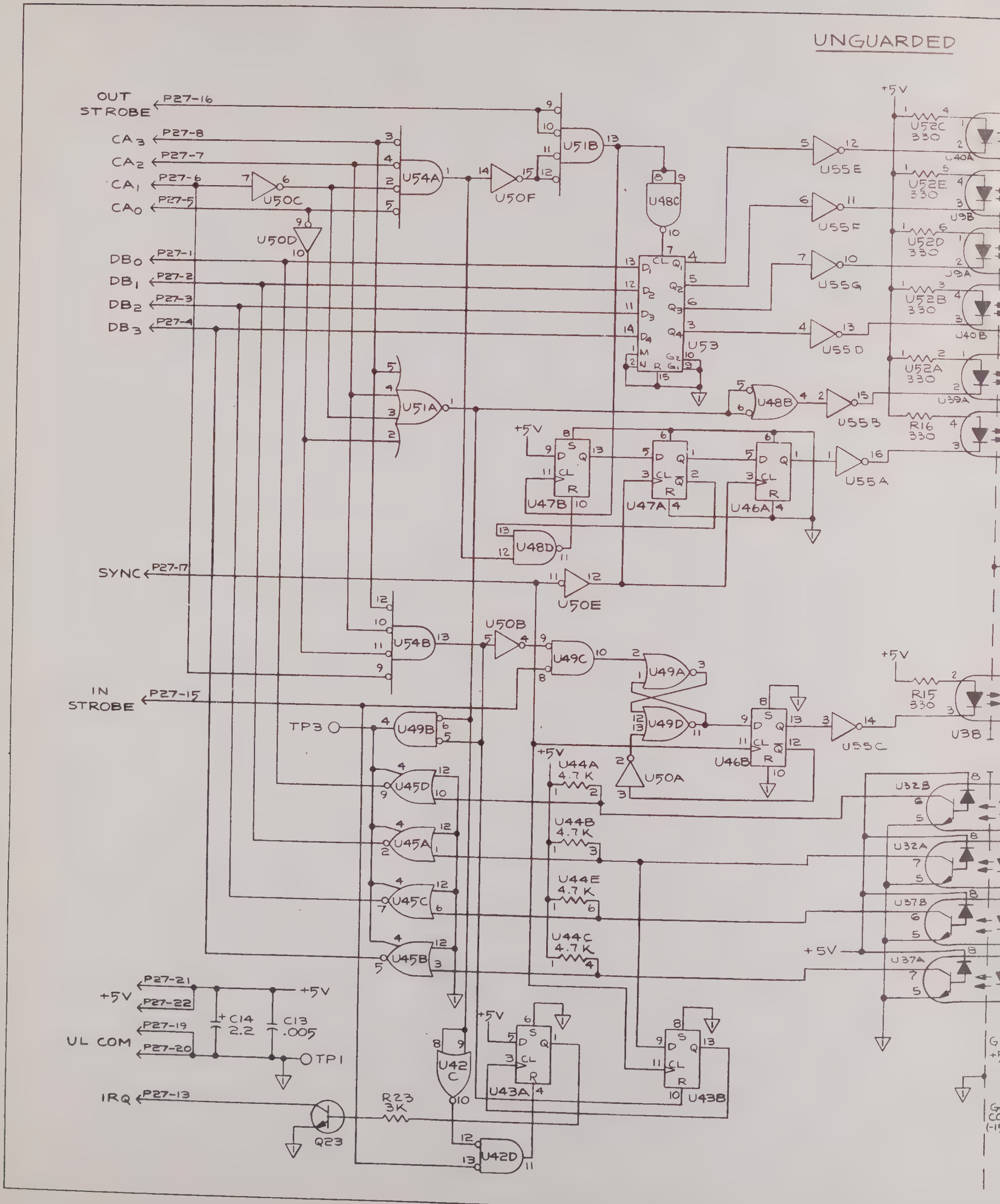
2200B-1010

Figure 8-8. A8 Basic Programmer PCB Assembly (cont)

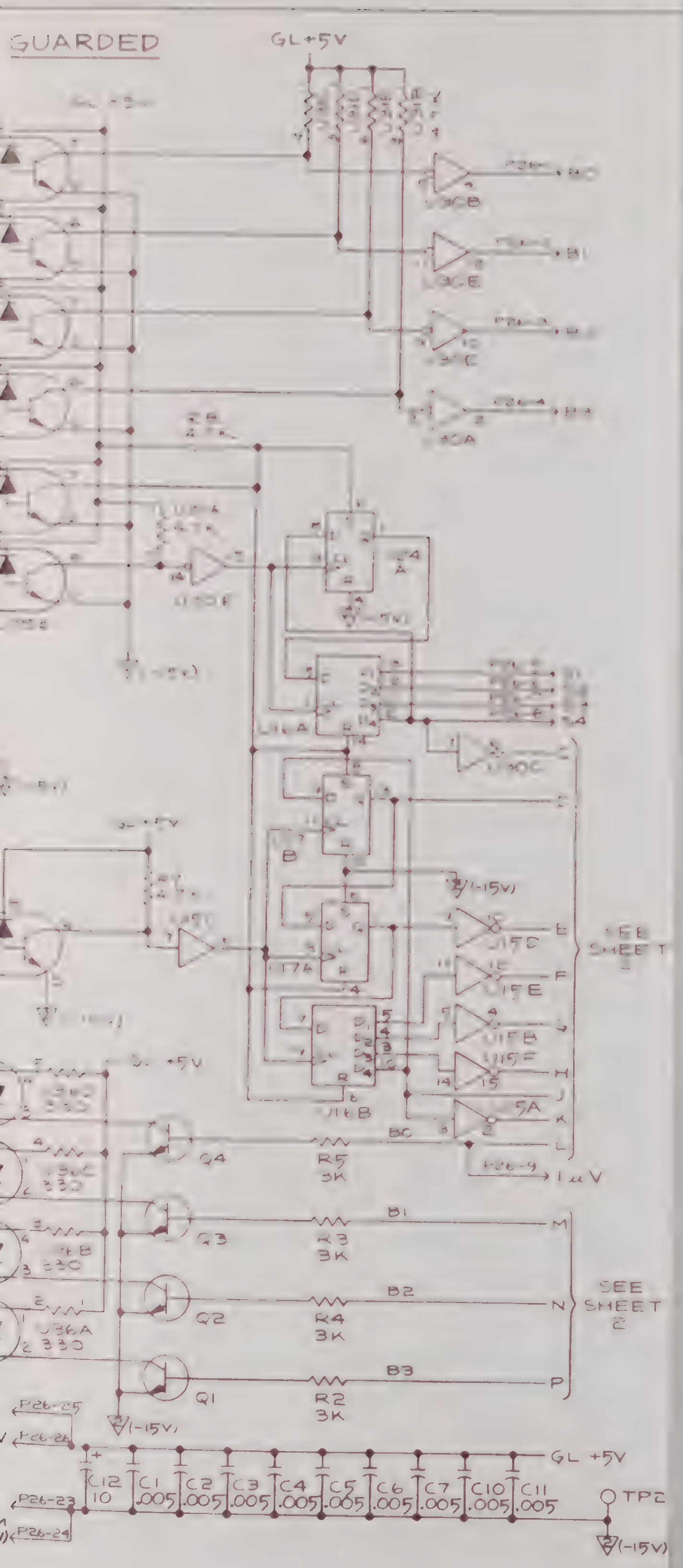

TP2
R2
U36
U44
U1
U2
U3
U4
U5
U6
C2
U7
R1
U8
Q1
U37
R3
R4
Q2
U32
Q3
U42
U43
U45
TP1
C1
R5
Q4
U10
U11
U12
U13
C3
U14
C4
U15
U16
U17
U46
U47
U48
TP6
R7
Q23
U18
U19
U20
C5
U21
U22
U23
U24
U38
TP3
U49
U50
U51
R21
C6
R8
U39
C13
C7
U25
C9
U26
U27
U28
C20
C10
U29
U30
U31
U52
U55
U53
U54
C8
U40
C21
U9
TP4
TP5
Y1
U34
U35
C12
C11
C14
P26
P27

2200A-1604

Figure 8-9. A4 Guard Crossing PCB Assembly



UNGUARDED
OUT STROBE
P27-16
CA3
P27-8
CA2
P27-7
CA1
P27-6
CA0
P27-5
DB0
P27-1
DB1
P27-2
DB2
P27-3
DB3
P27-4
SYNC
P27-17
IN STROBE
P27-15
TP3
+5V
P27-21
P27-22
UL COM
P27-19
P27-20
IRQ
P27-13
U54A
U50C
U50D
U50F
U51B
U48C
U53
U55E
U55F
U55G
U55D
U55B
U55A
U55C
U51A
U48B
U47B
U47A
U46A
U48D
U50E
U54B
U50B
U49C
U49A
U49D
U46B
U50A
U49B
U45D
U45A
U45C
U45B
U44A 4.7K
U44B 4.7K
U44E 4.7K
U44C 4.7K
U42C
U42D
U43A
U43B
Q23
R23 3K
C14 2.2
C13 .005
TP1
U52C 330
U52E 330
U52D 330
U52B 330
U52A 330
R16 330
R15 330
U40A
U9B
U9A
U40B
U39A
U38
U32B
U32A
U37B
U37A
+5V


GUARDED
GL+5V
U36B
U36E
U36E
U40A
U44A
U30F
U16A
U30C
U17A
U15D
U15E
U15B
U15F
U16B
U15A
SEE SHEET 2
E
F
G
H
J
K
L
BC
B1
B2
B3
Q4
Q3
Q2
Q1
R5 3K
R3 3K
R4 3K
R2 3K
P26-9
1 μV
M
N
P
U36C 330
U36B 330
U36A 330
▽(-15V)
P26-25
P26-26
P26-23
P26-24
GL +5V
C12 10
C1 .005
C2 .005
C3 .005
C4 .005
C5 .005
C6 .005
C7 .005
C10 .005
C11 .005
TP2
▽(-15V)

NOTES:

1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.

3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.

4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.

6. ▽ DENOTES UNGUARDED LOGIC COMMON (UL COM).

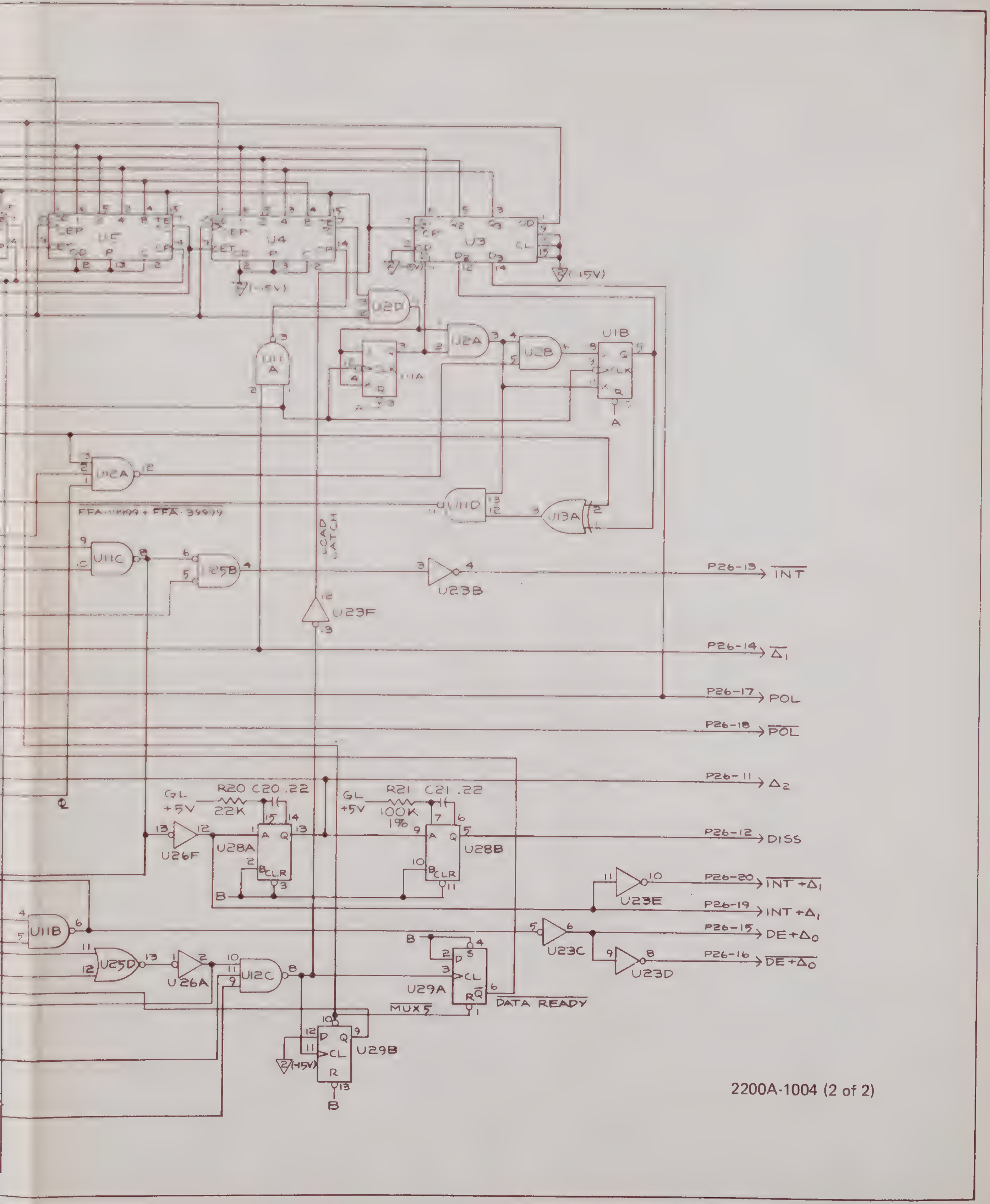
7. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM (-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.

8. ALL VOLTAGES NOTED WITHIN GUARDED SECTION OF INSTRUMENT ARE WITH RESPECT TO A/D COM.

IC REF. DES.	PIN NO.			
	+5V	UL COM	GL +5V	▽(-15V)
U1	—	—	14	7
U2	—	—	14	7
U3	—	—	16	8
U4	—	—	16	8
U5	—	—	16	8
U6	—	—	16	8
U7	—	—	16	8
U8	—	—	14	7
U10	—	—	14	7
U11	—	—	14	7
U12	—	—	14	7
U13	—	—	14	7
U14	—	—	14	7
U15	—	—	1,16	8
U16	—	—	16	8
U17	—	—	14	7
U18	—	—	14	7
U19	—	—	14	7
U20	—	—	14	7
U21	—	—	14	7
U22	—	—	14	7
U23	—	—	14	7
U24	—	—	14	4,7-11
U25	—	—	14	7
U26	—	—	14	7
U27	—	—	14	7
U28	—	—	16	8
U29	—	—	14	7
U30	—	—	1,16	8
U34	—	—	5	10
U35	—	—	14	7
U42	14	1,2,5,7	—	—
U43	14	7	—	—
U45	16	8,12,13,[illegible]	—	—
U46	14	7	—	—
U47	14	7	—	—
U48	14	1,3,7	—	—
U49	14	7	—	—
U50	1,16	8	—	—
U51	14	7	—	—
U53	16	8	—	—
U54	14	7	—	—
U55	9	8	—	—

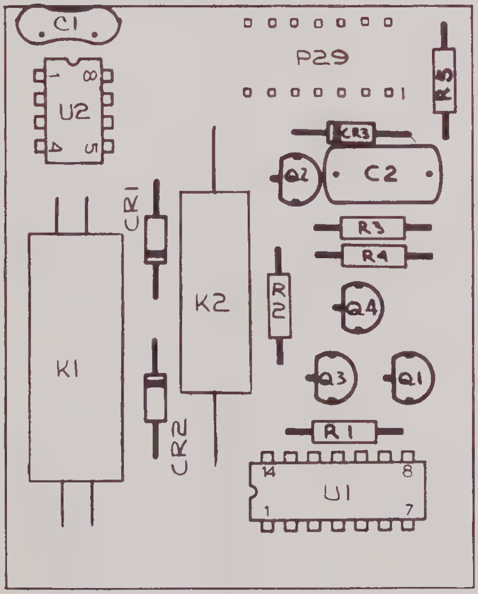
2200A-1004 (1 of 2)

Figure 8-9. A4 Guard Crossing PCB Assembly (cont)

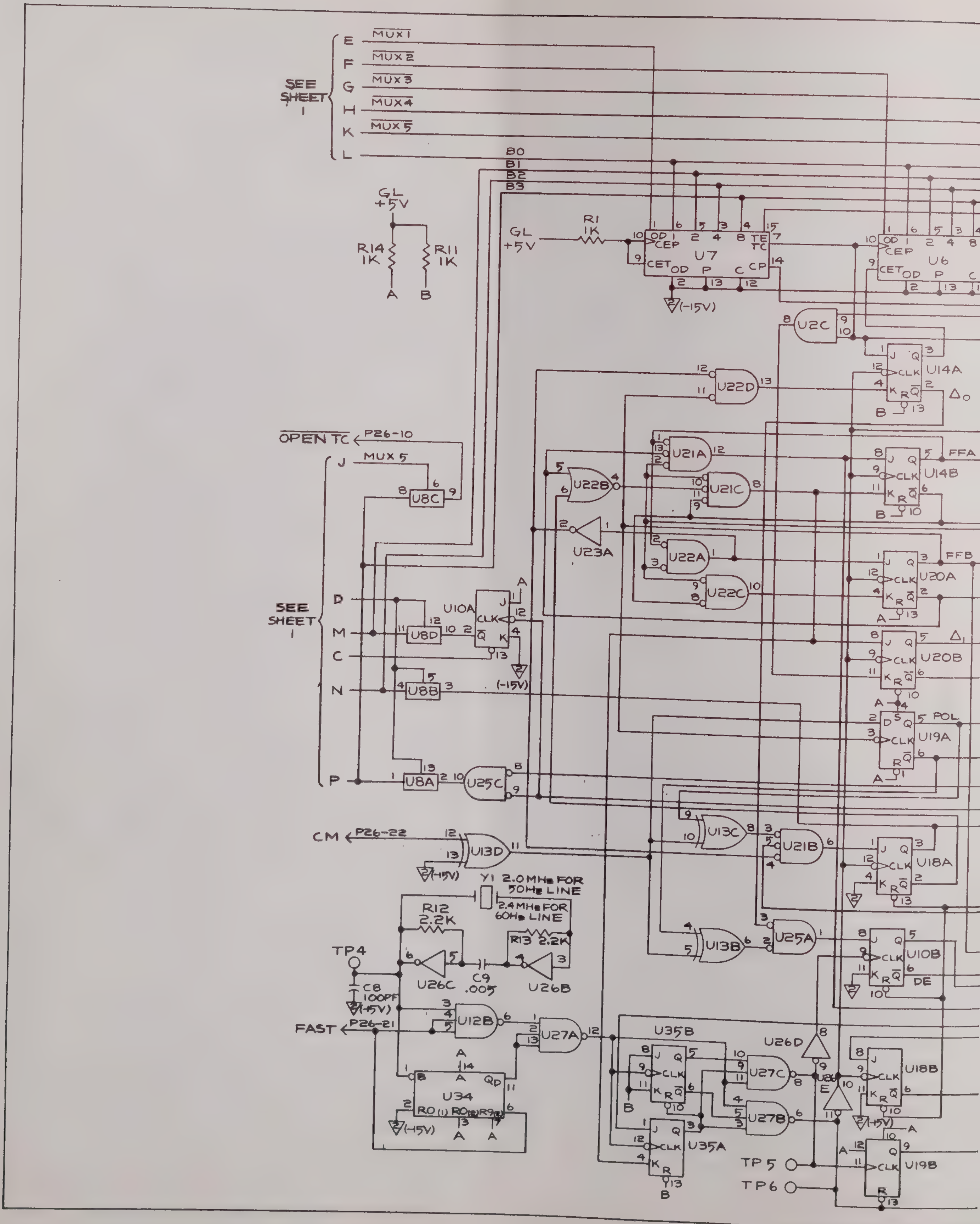

U5
U4
U3
(+5V)
(15V)
U2D
U2A
U2B
U1B
U1A
U11A
A
U12A
FFA·19999 + FFA·39999
U11D
U13A
LOAD LATCH
U11C
U25B
U23B
U23F
P26-13 INT
P26-14 Δ1
P26-17 POL
P26-18 POL
P26-11 Δ2
Q
GL +5V
R20 C20 .22
22K
R21 C21 .22
100K 1%
U26F
U28A
U28B
CLR
P26-12 DISS
U23E
P26-20 INT + Δ1
P26-19 INT + Δ1
B
U11B
U25D
U26A
U12C
U23C
U23D
P26-15 DE + Δ0
P26-16 DE + Δ0
U29A
DATA READY
MUX5
U29B
(+5V)

2200A-1004 (2 of 2)

Figure 8-9. A4 Guard Crossing PCB Assembly (cont)


C1
P29
1
8
U2
4
5
R5
CR3
Q2
C2
CR1
R3
R4
K2
R2
Q4
K1
Q3
Q1
R1
CR2
14
8
U1
1
7

2200A-1621


SEE SHEET 1
E MUX1
F MUX2
G MUX3
H MUX4
K MUX5
L
B0
B1
B2
B3
GL +5V
R14 1K
R11 1K
A
B
R1 1K
U7
OD CEP CET TE TC CP
(-15V)
U6
U2C
U14A
Δ0
U22D
OPEN TC P26-10
J MUX 5
U8C
U21A
U21C
U22B
U23A
U14B
FFA
U22A
U22C
U20A
FFB
SEE SHEET 1
D
M
C
N
P
U10A
U8D
U8B
(-15V)
U20B
Δ1
U19A
POL
U8A
U25C
CM P26-22
U13D
U13C
U21B
U18A
Y1 2.0MHz FOR 50Hz LINE
2.4MHz FOR 60Hz LINE
R12 2.2K
R13 2.2K
C9 .005
U26C
U26B
TP4
C8 100PF
(-15V)
FAST P26-21
U12B
U27A
U13B
U25A
U10B
DE
U34
RO(1) RO(2) R9(1) R9(2)
(-15V)
U35B
U26D
U27C
U27B
U35A
U18B
U19B
TP 5
TP 6
(-15V)

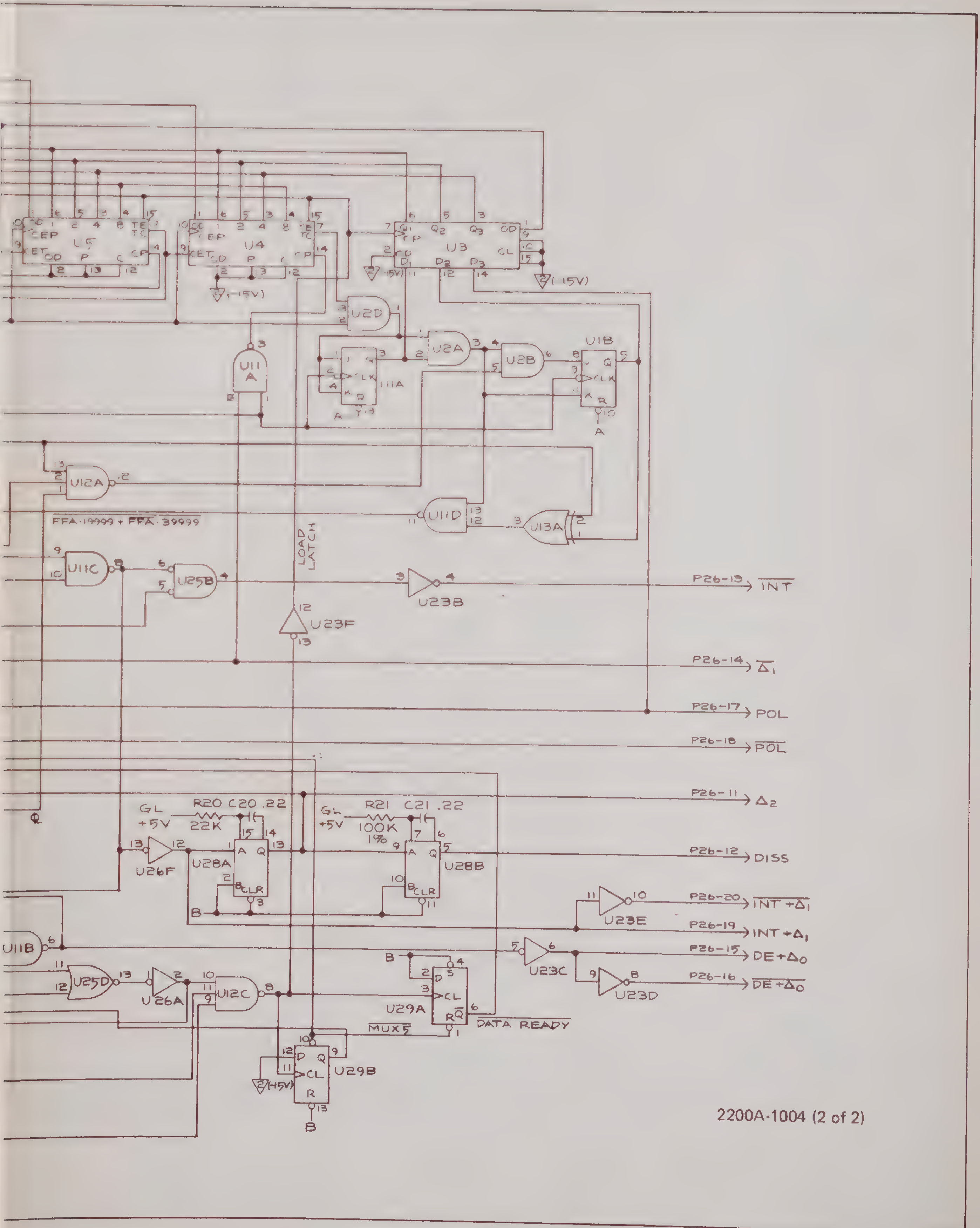
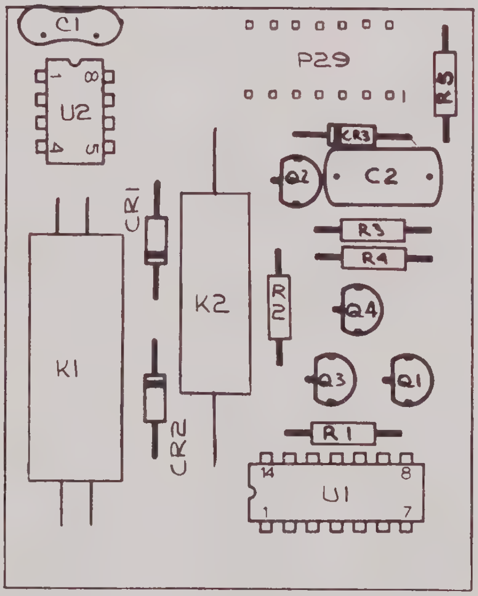

U5
U4
U3
U2D
U2A
U2B
U1B
U11A
U11D
U11C
U11B
U1IA
U12A
U12C
U13A
U25B
U25D
U23B
U23F
U23E
U23C
U23D
U26F
U26A
U28A
U28B
U29A
U29B
(-15V)
(+5V)
LOAD LATCH
FFA·19999 + FFA·39999
R20 22K
C20 .22
R21 100K 1%
C21 .22
GL +5V
DATA READY
MUX5
P26-13 INT
P26-14 Δ1
P26-17 POL
P26-18 POL
P26-11 Δ2
P26-12 DISS
P26-20 INT+Δ1
P26-19 INT+Δ1
P26-15 DE+Δ0
P26-16 DE+Δ0
A
B
2200A-1004 (2 of 2)

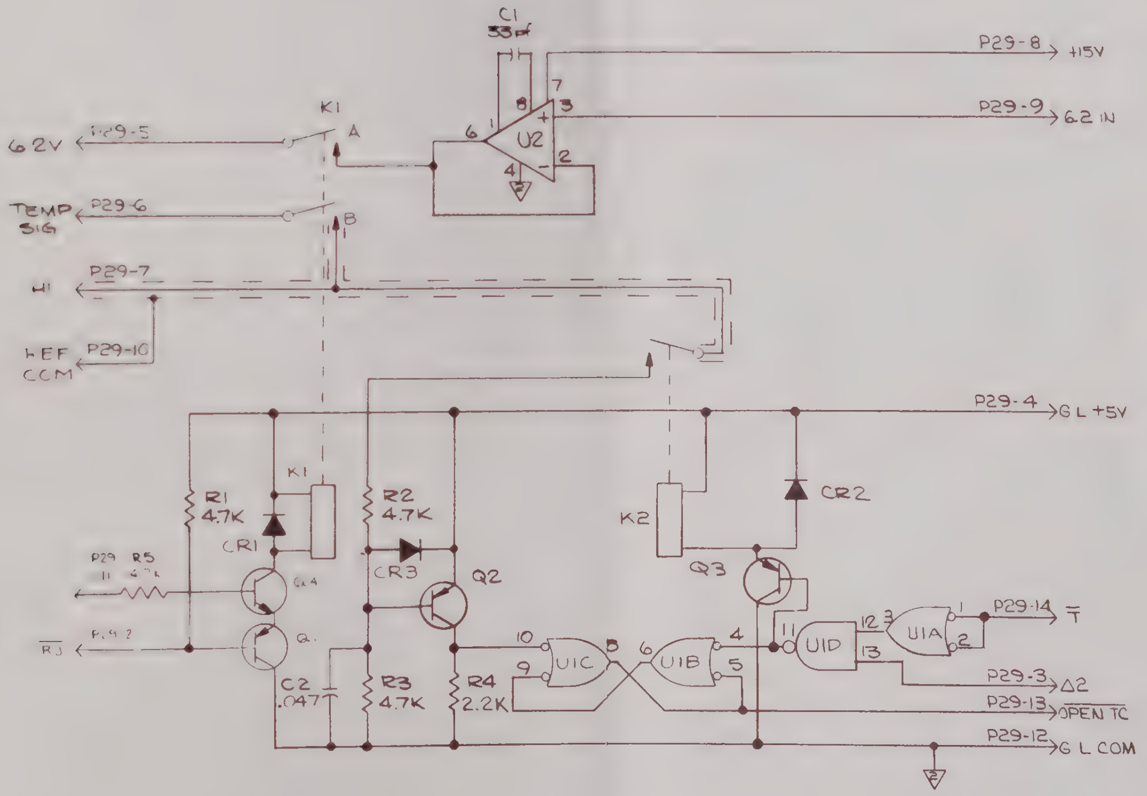
Figure 8-9. A4 Guard Crossing PCB Assembly (cont)


C1
U2
1
8
4
5
P29
1
R5
CR3
Q2
C2
CR1
R3
R4
K2
R2
Q4
K1
Q3
Q1
CR2
R1
14
8
U1
1
7

2200A-1621

NOTES:

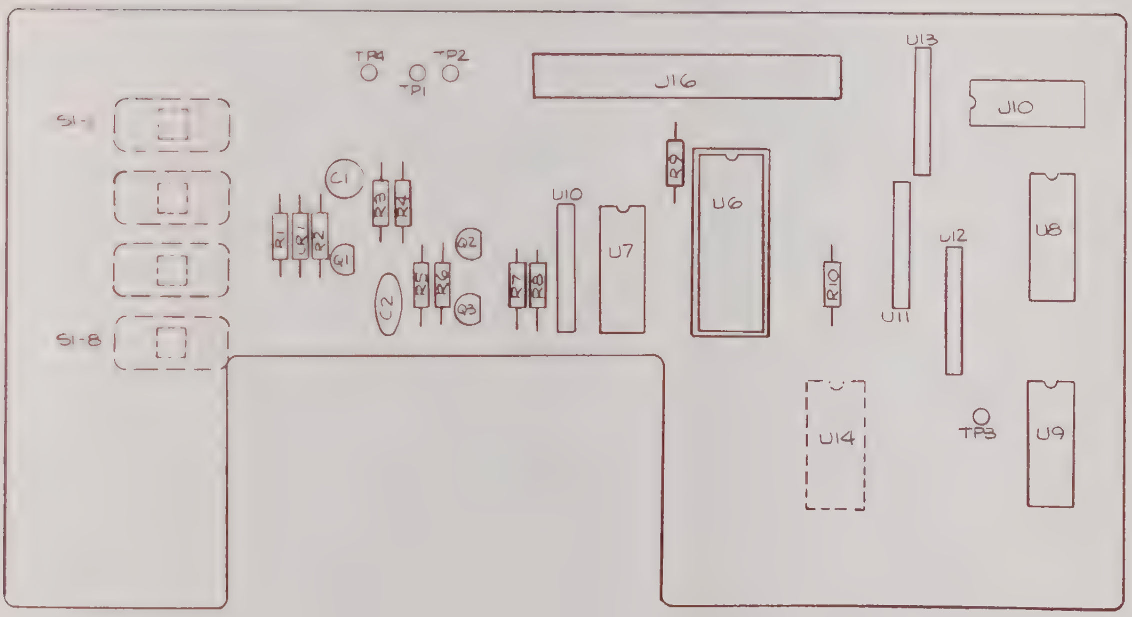
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ▽ DENOTES GUARDED LOGIC COMMON (GL COM)
3. ALL RESISTORS ARE 1/4W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.


C1
33pf
P29-8
+15V
7
8
3
P29-9
6.2 IN
K1
A
6.2V
P29-5
6
1
U2
2
4
TEMP SIG
P29-6
B
HI
P29-7
L
REF COM
P29-10
P29-4
GL +5V
K1
R1
4.7K
CR1
R2
4.7K
CR3
Q2
K2
CR2
Q3
P29
R5
11
4.7K
Q4
RJ
P29-2
Q
C2
.047
R3
4.7K
R4
2.2K
10
9
U1C
8
6
U1B
4
5
11
U1D
12
13
3
U1A
1
2
P29-14
T
P29-3
Δ2
P29-13
OPEN TC
P29-12
G L COM

IC	PIN NUMBER	
REF DES	G L +5V	G L COM
U1	14	7
U2	—	4

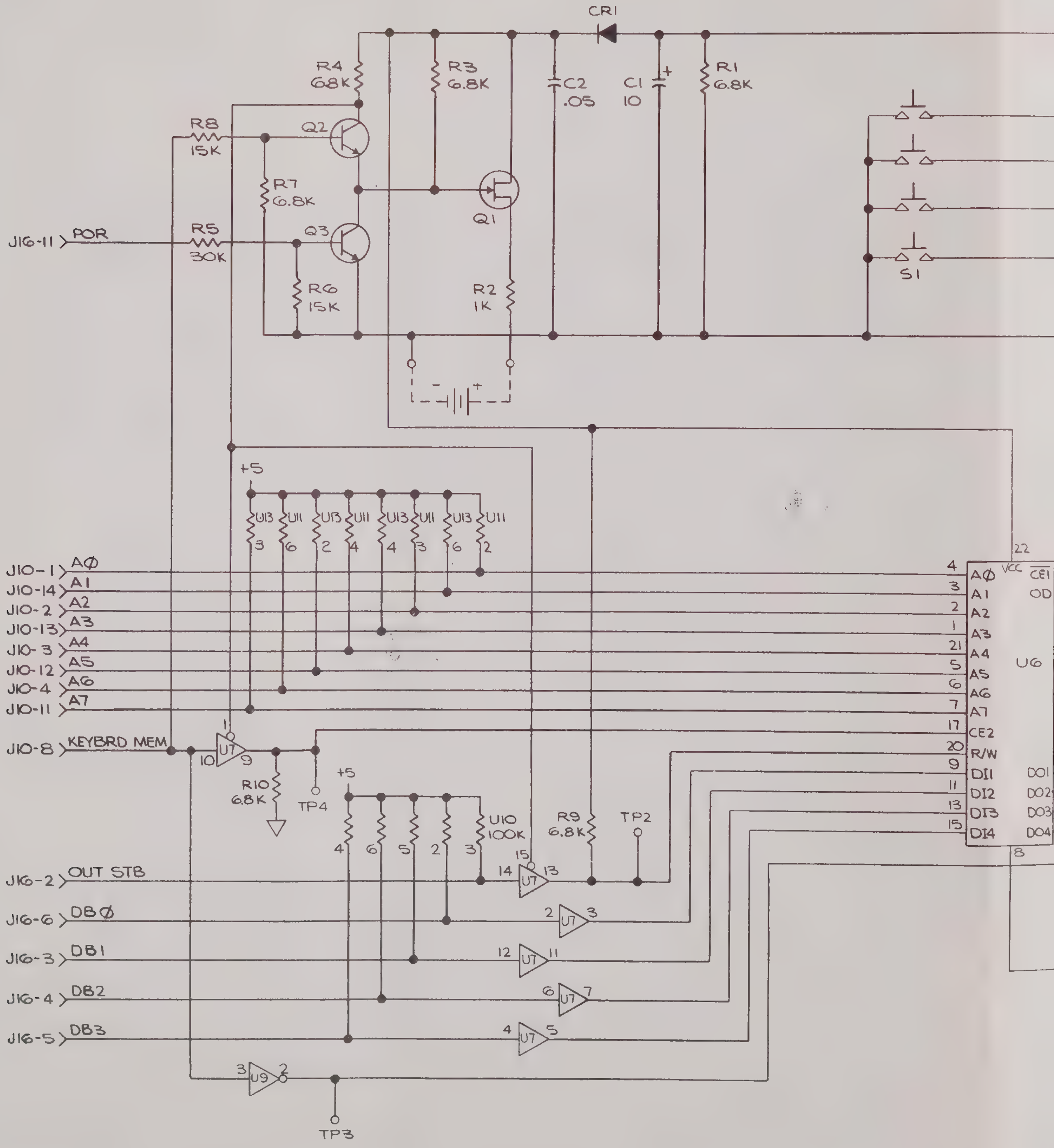
2200A-1021

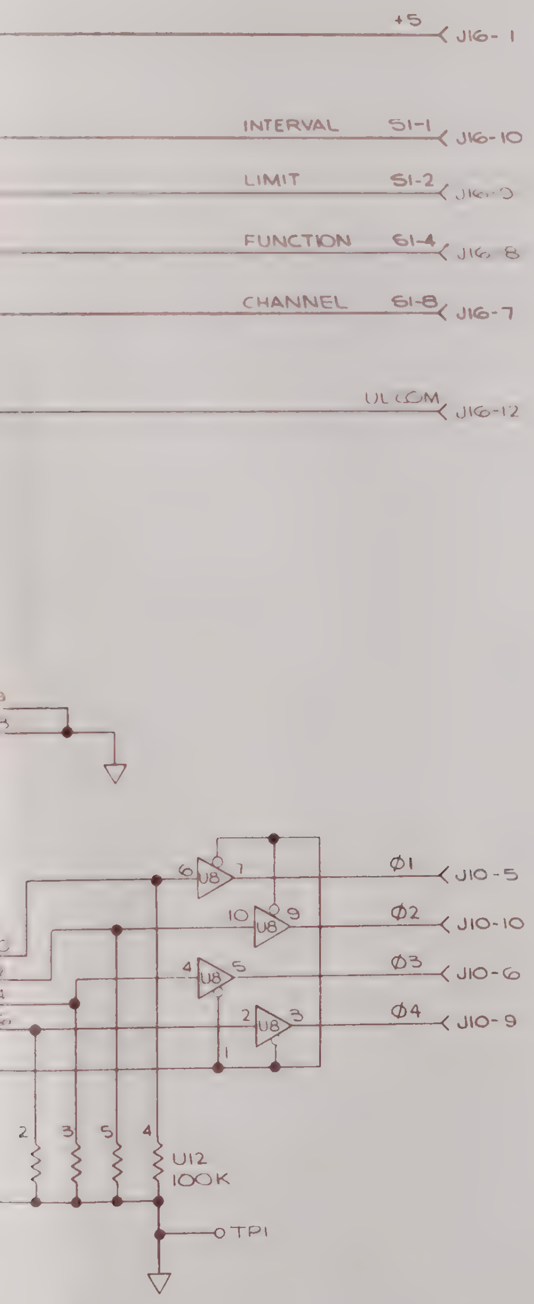
Figure 8-10. A11 Temperature PCB Assembly

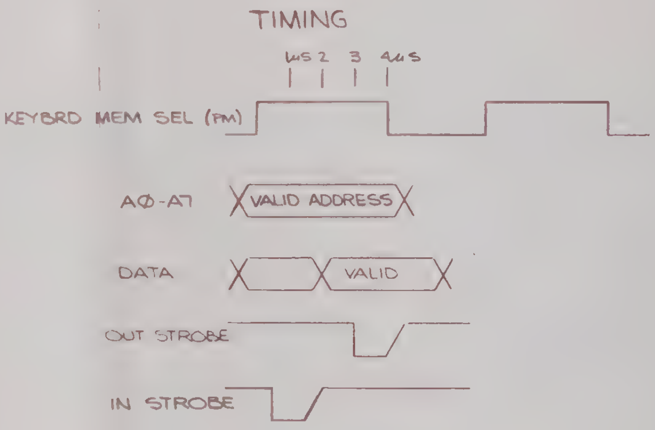

TP4
TP2
TP1
J16
U13
J10
S1-1
C1
R3
R4
R9
U6
U10
U7
R1
CR1
R2
Q2
Q1
U12
U8
R5
R6
R7
R8
R10
C2
Q3
U11
S1-8
U14
TP3
U9

2200B-1631

Figure 8-11. A9 Block Programmer/Memory PCB Assembly


CR1
R4 6.8K
R3 6.8K
C2 .05
C1 10
R1 6.8K
R8 15K
Q2
R7 6.8K
Q1
J16-11 POR
R5 30K
Q3
R6 15K
R2 1K
S1
+5
U13 3
U11 6
U13 2
U11 4
U13 4
U11 3
U13 6
U11 2
J10-1 A0
J10-14 A1
J10-2 A2
J10-13 A3
J10-3 A4
J10-12 A5
J10-4 A6
J10-11 A7
J10-8 KEYBRD MEM
U7 1 10 9
R10 6.8K
TP4
+5
U10 100K
4 6 5 2 3
R9 6.8K
TP2
J16-2 OUT STB
U7 14 15 13
J16-6 DB0
U7 2 3
J16-3 DB1
U7 12 11
J16-4 DB2
U7 6 7
J16-5 DB3
U7 4 5
U9 3 2
TP3
22
VCC
CE1
OD
4 A0
3 A1
2 A2
1 A3
21 A4
5 A5
6 A6
7 A7
U6
17 CE2
20 R/W
9 DI1
11 DI2
13 DI3
15 DI4
DO1
DO2
DO3
DO4
8


+5
J16- 1
INTERVAL
S1-1
J16-10
LIMIT
S1-2
J16-9
FUNCTION
S1-4
J16-8
CHANNEL
S1-8
J16-7
UL COM
J16-12
Ø1
J10-5
Ø2
J10-10
Ø3
J10-6
Ø4
J10-9
U8
6
7
10
9
4
5
2
3
1
2
3
5
4
U12
100K
TP1


TIMING
1µS 2 3 4µS
KEYBRD MEM SEL (PM)
AØ-A7
VALID ADDRESS
DATA
VALID
OUT STROBE
IN STROBE

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTANCE IS IN OHMS AND ALL CAPACITANCE IS IN MICROFARADS.
2. ALL GRAPHIC SYMBOLS ARE IN ACCORDANCE WITH ANSI Y32.2 AND Y32.14.

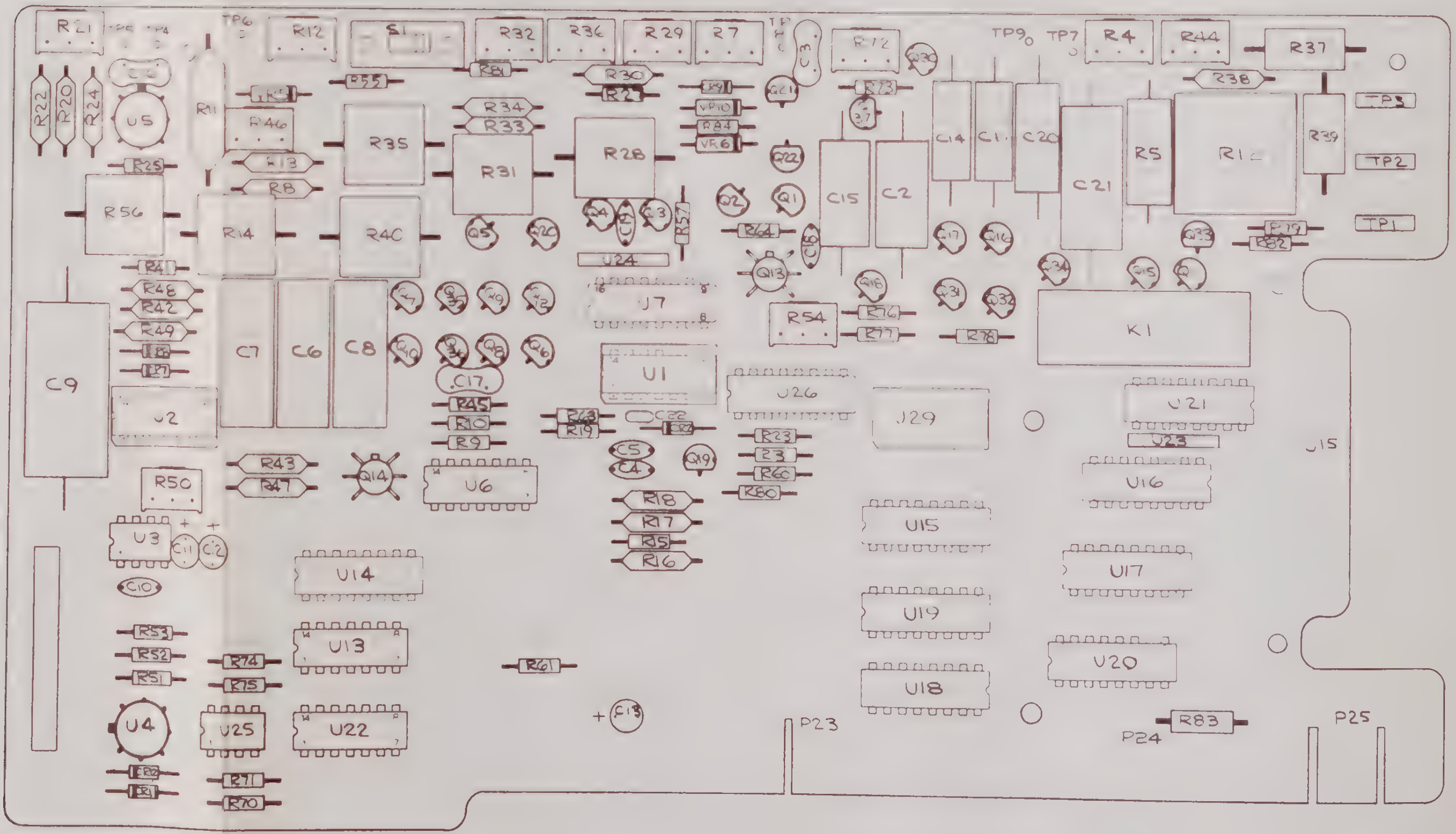
REF DES	+5	BAT	GND
U6		22	8, 18, 19
U7		16	8
U8	16		8
U9	1		5,7,8,9,11,14
U10	1		
U11	1		
U12			1
U13	1		

LAST USED	
R10	C2
CR1	Q3
U13	S1

NOT USED
U1-5

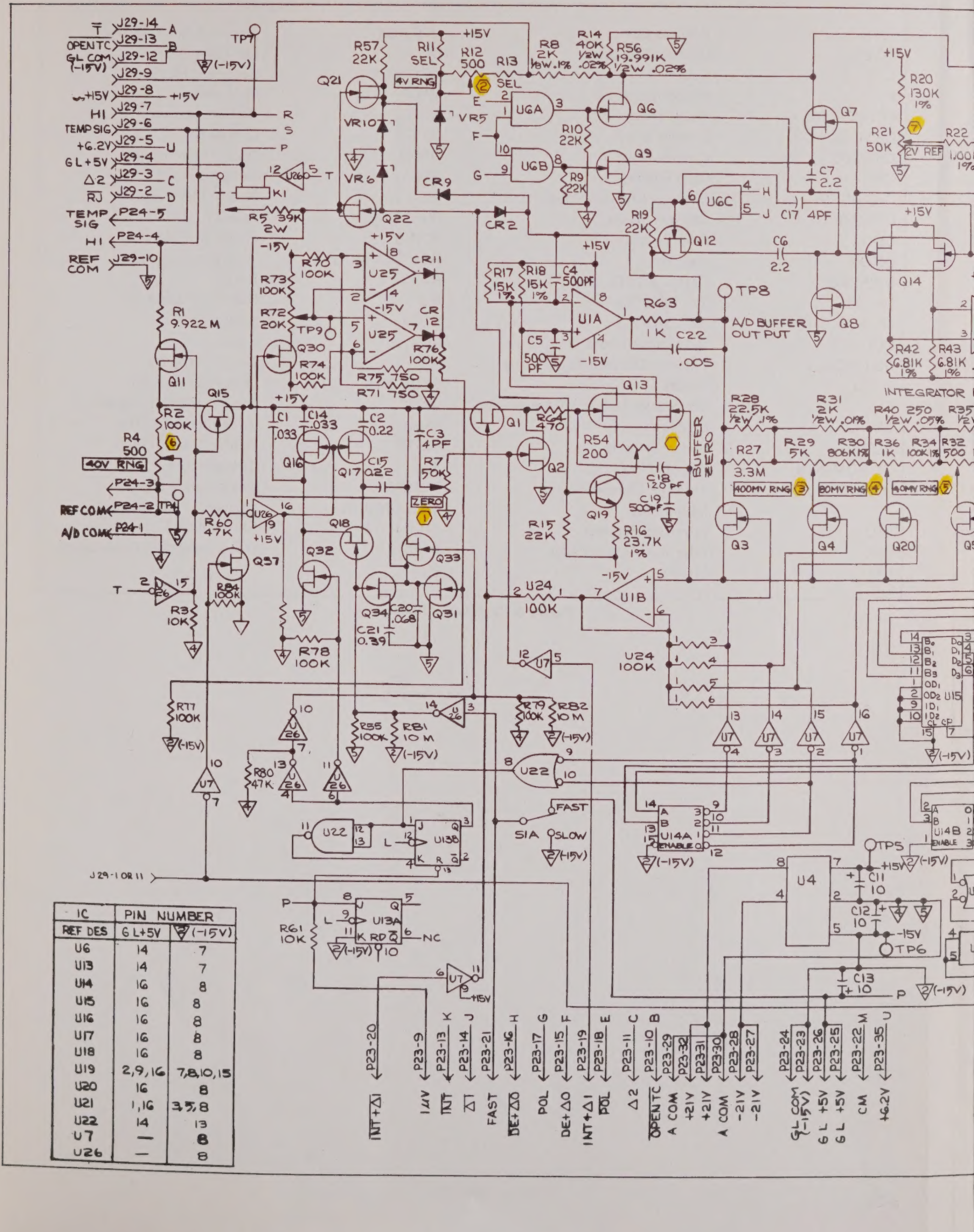
2200B-1031

Figure 8-11. A9 Block Programmer/Memory PCB Assembly (cont)

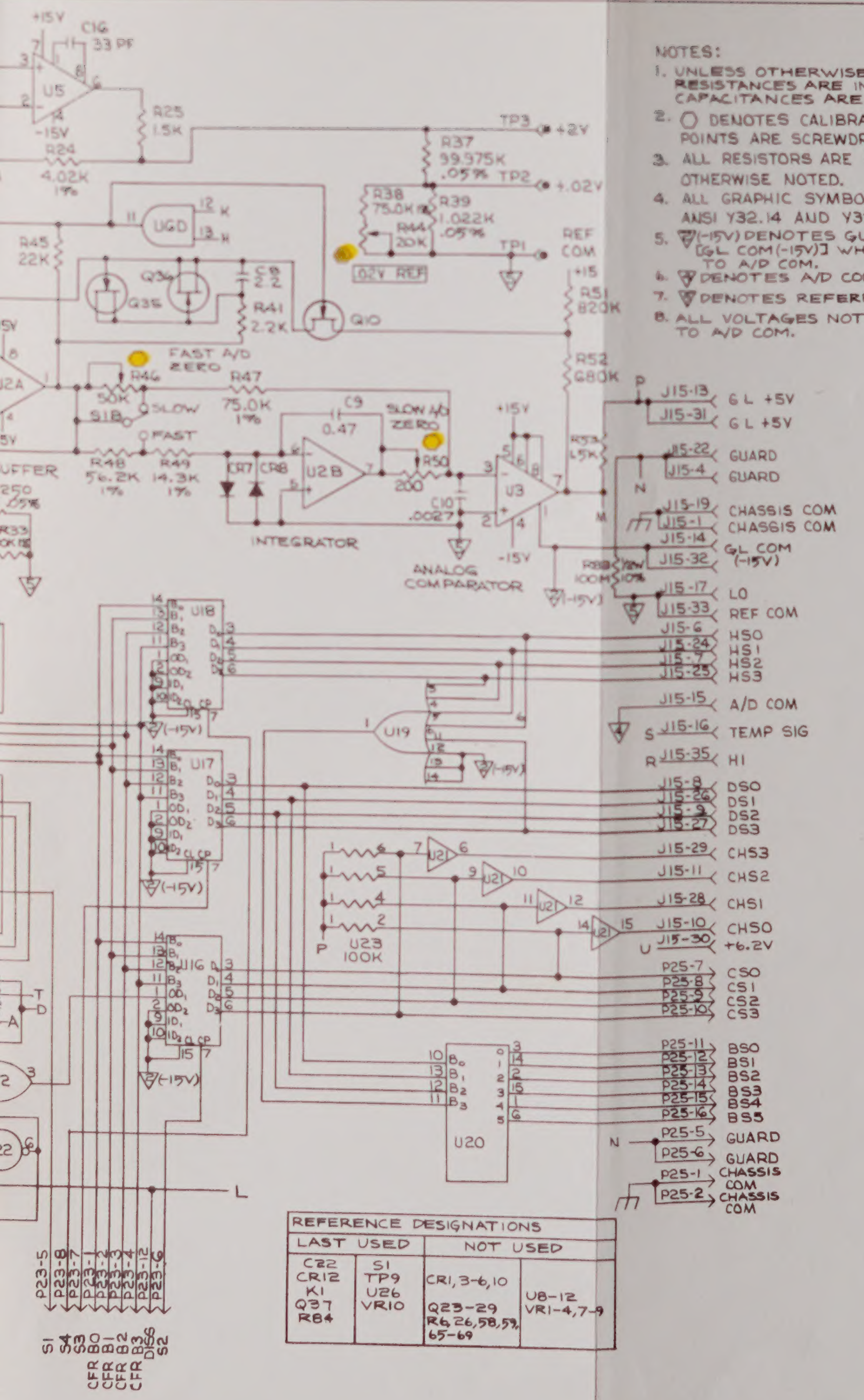

R21
TP6
R12
S1
R32
R36
R29
R7
C3
R72
TP9
TP7
R4
R44
R37
R22
R20
R24
U5
R11
R46
R55
R81
R30
R27
R73
Q30
Q21
R38
TP3
R34
R33
R35
R31
R28
Q22
C14
C1
C20
R5
R39
TP2
R25
R13
R8
C21
R56
R14
R4C
Q5
Q4
Q3
R57
Q2
Q1
C15
C2
R64
Q17
Q16
Q33
R79
R82
TP1
R41
R48
R42
R49
U24
Q13
C16
Q18
Q34
Q31
Q32
Q15
U7
R54
R76
R77
R78
K1
C9
C7
C6
C8
U1
C17
U26
J29
U21
U2
R45
R10
R9
R63
R19
C22
R23
R60
U23
U15
R43
R47
Q14
U6
C5
C4
Q19
R80
U16
R50
R18
R17
R15
R16
U3
C11
C2
U14
U17
C10
U19
R53
R52
R51
R74
R75
U13
R61
U20
U18
U4
U25
U22
C13
P23
P24
R83
P25
R71
R70

2200B-1628

Figure 8-12. A10 High Performance A/D Converter PCB Assembly


T J29-14 A
OPEN TC J29-13 B
GL COM (-15V) J29-12
J29-9
+15V J29-8 +15V
HI J29-7
TEMP SIG J29-6
+6.2V J29-5 U
GL+5V J29-4
Δ2 J29-3 C
RJ J29-2 D
TEMP SIG P24-5
HI P24-4
REF COM J29-10
TP7
(-15V)
R
S
P
T
K1
U26
R5 39K 2W
-15V
R57 22K
Q21
VR10
VR6
Q22
R11 SEL
R12 500
4V RNG
2
VR5
+15V
R8 2K 1/8W .1%
R13
SEL
R14 40K 1/2W .02%
R56 19.991K 1/2W .02%
U6A
U6B
E
F
G
Q6
Q9
R10 22K
R9 22K
CR9
CR2
Q7
C7 2.2
R19 22K
U6C
H
J
C17 4PF
Q12
C6 2.2
+15V
R20 130K 1%
R21 50K
7
2V REF
R22 1,00 1%
Q14
Q8
R42 6.81K 1%
R43 6.81K 1%
INTEGRATOR
R1 9.922 M
Q11
Q15
R2 100K
R4 500
6
40V RNG
P24-3
REF COM P24-2 TP4
A/D COM P24-1
R70 100K
R73 100K
R72 20K
TP9
U25
CR11
CR12
Q30
R74 100K
R76 100K
R75 750
R71 750
C1 .033
C14 .033
C2 0.22
Q16
Q17
C15 0.22
C3 4PF
R7 50K
ZERO
1
Q1
R64 470
Q2
Q13
R54 200
BUFFER ZERO
R17 15K 1%
R18 15K 1%
C4 500PF
C5 500 PF
U1A
R63 1K
C22 .005
TP8
A/D BUFFER OUTPUT
C18 120 PF
C19 500PF
Q19
R15 22K
R16 23.7K 1%
R28 22.5K 1/2W .1%
R31 2K 1/2W .01%
R40 250 1/2W .05%
R35
R27 3.3M
R29 5K
R30 806K 1%
R36 1K
R34 100K 1%
R32 500
400MV RNG 3
80MV RNG 4
40MV RNG 5
Q3
Q4
Q20
Q5
R60 47K
U26
+15V
Q18
Q32
Q33
Q37
R84 100K
T
U26
R3 10K
Q34
Q31
C20 .068
C21 0.39
R78 100K
U24 100K
U1B
-15V
U7
U24 100K
U7
R77 100K
(-15V)
U7
J29-1 OR 11
U26
R80 47K
R55 100K
R81 10M
R79 100K
R82 10M
(-15V)
U22
U13B
J K Q R
L
FAST
S1A
SLOW
(-15V)
U14A
ENABLE
U15
U14B
ENABLE
TP5
+15V
U4
C11 10
C12 10
-15V
TP6
C13 10
P
(-15V)
P
U13A
R61 10K
L
NC
(-15V)
U7
+15V
P23-20 INT+ΔI
P23-9 1μV
P23-13 K INT
P23-14 J ΔT
P23-21 FAST
P23-16 H DE+ΔΘ
P23-17 G POL
P23-15 F DE+ΔΘ
P23-19 INT+ΔI
P23-18 E POL
P23-11 C Δ2
P23-10 B OPEN TC
P23-29 A COM
P23-32 +21V
P23-31 +21V
P23-30 A COM
P23-28 -21V
P23-27 -21V
P23-24 GL COM (-15V)
P23-23 GL +5V
P23-26 GL +5V
P23-25 CM
P23-22 M +6.2V
P23-35 U

IC	PIN NUMBER	
REF DES	G L+5V	(-15V)
U6	14	7
U13	14	7
U14	16	8
U15	16	8
U16	16	8
U17	16	8
U18	16	8
U19	2,9,16	7,8,10,15
U20	16	8
U21	1,16	3,5,8
U22	14	13
U7	—	8
U26	—	8


+15V
C16 33 PF
U5
-15V
R25 1.5K
R24 4.02K 1%
TP3 +2V
R37 99.975K .05%
TP2 +.02V
R38 75.0K
R39 1.022K .05%
R44 20K
.02V REF
TP1
REF COM
UGD
R45 22K
Q36
Q35
C8 2.2
R41 2.2K
Q10
+15
R51 820K
FAST A/D ZERO
R46 50K
R47 75.0K 1%
S1B
SLOW
FAST
R52 680K
C9 0.47
SLOW A/D ZERO
R50 200
U2B
CR7
CR8
R48 56.2K 1%
R49 14.3K 1%
C10 .0027
INTEGRATOR
ANALOG COMPARATOR
+15V
-15V
U3
R53 15K
R88 100M 10%
BUFFER
R33
U18
U17
U16
U19
U2
U23 100K
U20
J15-13 GL +5V
J15-31 GL +5V
J15-22 GUARD
J15-4 GUARD
J15-19 CHASSIS COM
J15-1 CHASSIS COM
J15-14
J15-32 GL COM (-15V)
J15-17 LO
J15-33 REF COM
J15-6 HS0
J15-24 HS1
J15-7 HS2
J15-25 HS3
J15-15 A/D COM
J15-16 TEMP SIG
J15-35 HI
J15-8 DS0
J15-26 DS1
J15-9 DS2
J15-27 DS3
J15-29 CHS3
J15-11 CHS2
J15-28 CHS1
J15-10 CHS0
J15-30 +6.2V
P25-7 CS0
P25-8 CS1
P25-9 CS2
P25-10 CS3
P25-11 BS0
P25-12 BS1
P25-13 BS2
P25-14 BS3
P25-15 BS4
P25-16 BS5
P25-5 GUARD
P25-6 GUARD
P25-1 CHASSIS COM
P25-2 CHASSIS COM
P23-5 S1
P23-8 S4
P23-7 S3
P23-1 CFR B0
P23-2 CFR B1
P23-3 CFR B2
P23-4 CFR B3
P23-12 DISS
P23-6 S2
L

NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCES ARE IN MICROFARADS.
2. ○ DENOTES CALIBRATION ADJ POINTS. ALL POINTS ARE SCREWDRIVER ADJUST.
3. ALL RESISTORS ARE 1/4 W, 5% UNLESS OTHERWISE NOTED.
4. ALL GRAPHIC SYMBOLS IN ACCORDANCE WITH ANSI Y32.14 AND Y32.2.
5. ▽(-15V) DENOTES GUARDED LOGIC COMMON [GL COM(-15V)] WHICH IS -15V WITH RESPECT TO A/D COM.
6. ▽ DENOTES A/D COMMON (A/D COM).
7. ▽ DENOTES REFERENCE COMMON (REF COM).
8. ALL VOLTAGES NOTED ARE WITH RESPECT TO A/D COM.

REFERENCE DESIGNATIONS			
LAST USED		NOT USED	
C22 CR12 K1 Q37 R84	S1 TP9 U26 VR10	CR1,3-6,10 Q23-29 R6,26,58,59,65-69	U8-12 VR1-4,7-9

2200A-1028

Figure 8-12. A10 High Performance A/D Converter PCB Assembly (cont)

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